The Impact of Peak Oil on Globalisation – An Example of Steel Exports to the United States

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by

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Abstract

Despite the potential importance of the link between peak oil and the geography of world trade, so far remarkably little research has been conducted for that matter. Particularly, there is a gap in the literature regarding the impact of peak oil on international trade patterns at the industry level. The dissertation contributes to filling that gap.

The study uses the VEC model approach to analyse the influence of peak oil on the geography of international trade, thereby using the example of steel exports to the United States between 1998 and 2008. The hypothesis tested is that peak oil, which involves high oil prices and rising international transport costs, leads to an increasing regionalisation of international trade flows at the cost of long-distance trade.

Steel exports to the U.S. are analysed by steel export category, country and region. Steel exports per steel product category are analysed for 18 countries, total steel exports are analysed for 64 countries, and steel exports per region are analysed for 8 regions. The findings suggest that following an oil price shock, steel export volumes decrease for countries/regions geographically distant to the U.S. and increase for countries/regions geographically close to the U.S.

The evidence also reveals the significant explanatory power oil prices have for steel exports to the United States and that price patterns play a role in the realignment process of international trade flows in the global steel industry. The findings are in line with economic trade theory with regard to the importance of the distance of trade and indicate that due to peak oil, trade globalisation, at least in the steel industry, may be at risk.

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Table of Contents (Overview)

List of Abbreviations

ACA	Australian Coal Association
ADF test	Augmented Dickey Fuller Test
AIC	Akaike Information Criterion
AISI	American Iron and Steel Institute
APEC	Asia-Pacific Economic Cooperation
APPGOPO	All Party Parliamentary Group on Peak Oil
AR(1)	First-Order Autoregressive Process
ASEAN	Association of Southeast Asian Nations
AUP	Average Unit Price
BEA	Bureau of Economic Analysis
BGR	Federal Institute for Geosciences and Natural Resources
BLS	U.S. Bureau of Labor Statistics
BOF	Basic Oxygen Furnace
bpd	barrels per day
CAN	Competitive Analysis of Nations
CIF	Cost, Insurance and Freight
C.I.S.	Commonwealth of Independent States
CMSA	Constant Market Share Analysis
CPI	U.S. Consumer Price Index
DF test	Dickey Fuller Test
DOC	U.S. Department of Commerce
DOE	U.S. Department of Energy
dwt	deadweight tonnage
EAF	Electric Arc Furnace
ECLAC	Economic Commission for Latin America and the Caribbean
EIA	U.S. Energy Information Administration
ECM	Error Correction Mechanism
EPA	U.S. Environmental Protection Agency
EROEI	Energy Return on Energy Investment
EU	European Union
EXRA	Exchange Rates
FED	Federal Reserve Bank
FOB	Free On Board
FRB	Federal Reserve Board
GATT	General Agreement on Tariffs and Trade
GC	Granger Causality
GCI	Global Competitiveness Index
GCR	Global Competitiveness Report
GDP	Gross Domestic Product
GPN	Global Production Network
GINFORS	Global Interindustry Forecasting System
GJ/t	Giga-Joule per ton
GSIM	Global Simulation Model
HQC	Hannan-Quinn Criterion
HS	Harmonized System
HTSUSA	Harmonized Tariff Schedule of the United States Annotate for Statistical Reporting Purposes
IEA	International Energy Agency
INFORGE	Interindustry Forecasting Germany
IRF	Impulse Response Function
IV-GMM	Instrumental Variable – Generalized Method of Moments
LM test	Lagrange Multiplier test

MAGIC	Model to Analyse International Trade Growth
MBtu/ton	Million British thermal units per ton
MEI	Main Economic Indicators
MERCOSUR	Mercado Común del Sur / Southern Common Market
mmt	million metric tons
MNC	Multinational Company
MSE	Mean Squared Error
mt	million tons
Mt	Mega tons
n.a.	not available
NAFTA	North American Free Trade Agreement
NAICS	North American Industry Classification System
NYMEX	New York Mercantile Exchange
OECD	Organisation for Economic Cooperation and Development
OLS	Original Least Squares
QMT	Quantity Metric Tons
RESET	Renewable Energy Shelter Environment Training
RGDP	U.S. Real GDP
s.d.	standard deviation
SEQ	Simultaneous Equation
SIC	Schwarz Information Criterion
SITC	Standard International Trade Classification
TEU	Twenty-Foot Equivalent Unit
tm	ton-mile
tmt/TMT	thousand metric tons
tst/TST	thousand short tons
UAE	United Arab Emirates
UK ITPOES	Industry Taskforce on Peak Oil and Energy Security
UNCTAD	United Nations Conference on Trade and Development
USGS	United States Geological Survey
USJFCOM	United States Joint Forces Command
USTIC	United States International Trade Commission
VALUE	U.S. Steel Import Value
VAR	Vector Autoregression
VD	Variance Decomposition
VEC	Vector Error Correction
VMA	Vector Moving Average
WCI	World Coal Institute
WSC	World Shipping Council
WTI	West Texas Intermediate
WTO	World Trade Organisation

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Introduction

During the 2000s, an oil production scenario referred to as peak oil theory achieved mainstream attention for the first time and was subject of intensive debates. The discussions regarding peak oil were fuelled by upward-spiralling oil prices and rapidly growing demand for crude oil. At the same time, an increasing number of geologists and forecasters stressed that conventional crude oil production will eventually reach a tipping point where oil supply cannot keep up with demand due to geological or physical limitations.

Against this backdrop, the dissertation analyses the impact of peak oil on the geography of international trade. Therefore, the purpose of the dissertation is to analyse the impact of higher oil prices rather than its causes. The hypothesis tested is that peak oil, which involves rising oil prices and international transport costs, will eventually lead to an increasing regionalisation of international trade flows at the cost of long-distance trade. In this context, the study analyses the variation of steel export volumes to the U.S. from 64 geographically close and geographically distant countries for the time period between 1998 and 2008 by applying the VEC model approach.

The dissertation is structured as follows: Chapter 1 defines the key terms for the dissertation topic, peak oil and globalisation. Chapter 2 then reviews the literature and chapter 3 analyses the interdependencies between peak oil, international ocean transport costs and trade globalisation. Subsequently, chapter 4 describes the datasets used in the econometric analysis while chapter 5 describes the adopted econometric approach. The econometric estimates obtained are analysed in chapter 6. Finally, chapter 7 links the findings of the econometric analysis to the history of globalisation and chapter 8 provides an outlook into possible future prospects and policy recommendations. Chapter 9 concludes.

1 Definition of Peak Oil and Globalisation

Disputes and confusion regularly start around issues of definition (Scholte 2005: 8). Therefore, in chapter 1 the two key terms for the dissertation, peak oil (1.1) and globalisation (1.2), are defined.

1.1 Hubbert's Law and Definition of Peak Oil

Section 1.1 first describes Hubbert's Law (1.1.1) and then defines peak oil (1.1.2).

1.1.1 Hubbert's Law

Hubbert's Law is a well-known depletion model invented by geologist Martin King Hubbert (Cavallo 2005; Sorrell et al. 2009). The model can generally be applied to various raw materials such as iron ore and fossil energy sources such as coal, natural gas or crude oil. The best-known application of Hubbert's Law is the peak oil theory which increasingly achieves mainstream attention[1] (Li 2007) and which is used below to describe Hubbert's model.

The peak oil theory implicates that once about half of the recoverable crude oil has been extracted from a given oilfield, production starts to decline (Illum 2004; Lahart 2006; Ryan 2005). The ideal-typical characteristic of production of a single oil well follows the pattern of a bell-shaped curve and can be subdivided into three phases. The first phase is characterised by a continuous expansion of oil production (pre-peak). During the second phase, the amount of oil that can be extracted per day flattens and an extraction-maximum is reached (at-peak or plateau). Finally, the production output begins to backslide (decline) (Cavallo 2002; Zittel and Schindler 2003).

Hubbert's Law assumes that a nation's oil production pattern also follows the pattern of a single oil well (Ball 2004). This implicates that the characteristic bell-shaped extraction process of a single well is also representative for aggregates of oilfields (Campbell et al. 2003; Fishman 2009). According to Hubbert, the peak of a nation's oil discoveries is followed by a time-delayed peak of oil production (Ball 2004; Campbell 2002). A cumulation of all curves for the standard distribution of all oil producing nations culminates in *one* 'Hubbert-Curve' representing the progression of conventional world oil production.

Hubbert applied his theory to the United States and concluded that U.S. oil production, excluding Alaska and Hawaii (Hoyos 2004), would peak between 1966 and 1971 (Robelius 2007; Wells 2005). Given the enormous U.S. spare capacity at the time of his prediction in 1956 (Cavallo 2005; Ryan 2005) and the steadily rising output of oil production, few experts took Hubbert seriously (Duncan 1999). However, Hubbert's prediction proved to be accurate as U.S. conventional oil production reached its all-time high in 1970 at 9.1 million bpd

(Deffeyes 2001: 1; Hallock et al. 2004; Wells 2005) eleven years after U.S. oil discoveries had peaked in 1959. Conventional U.S. crude oil production has declined since then.

Hubbert's accomplishment consists of the fact that he has directed attention from the reach of oil reserves to the global production maximum because the point in time at which conventional oil supply is not able to keep up with demand is of greater significance. The mathematical derivation of Hubbert's Law is described in the appendix, section A1.

1.1.2 Definition of Peak Oil

Peak oil refers to the point in time[2] at which global oil production reaches its physical limit and enters into a permanent decline (Leeb 2006: 88; Paul 2007: 200; UK ITPOES 2008). More precisely, peak oil describes the *period of time* in which the maximum of daily worldwide *conventional* crude oil production is reached.

However, the implication that peak oil would be predictable right on the day and that world oil production would immediately start to decline afterwards is wrong. On the one hand, there are determining factors on the supply side (geopolitical factors such as turmoil in the Middle East; technological factors such as oil production process developments) and the demand side (economic factors such as worldwide economic growth rates) that are not exactly pre-visible and can prepone or postpone peak oil in a time-frame of several years. On the other hand, it is possible that the occurrence of peak oil will only be recognised retrospectively (Friebe 2004; Simmons 2005).

Most likely, national and private oil companies will be anxious to maintain the extraction maximum by using all technology available, thereby keeping the conventional production level flat and creating a production plateau that might last for some time (Energy Economist 2005; Roberts 2004: 46). This may delay the decline of global conventional production (Paul 2007: 35). However, those measures could eventually lead to a time-delayed steeper and more sudden decline (Roberts 2004: 46). In this context, it is noteworthy that global conventional oil production stagnated between 2005 and 2008 (Hamilton 2008).

Peak oil will be (or has been[3]) a non-recurring historical incident and will presumably lead to economical and societal structural change as for the first time since the beginning of the Industrial Revolution, geological supply of an essential energy source will not keep up with demand (Deffeyes 2005: xi).

There are different perceptions of peak oil. A perception particularly proposed by geological circles is that the midpoint in oil production and the subsequent *physical* supply gap that will open up for the first time in history will cause an oil price shock[4] (Stieler 2006) and non-linear oil price increases (Jung 2006).

Economic circles advocating the peak oil theory have a rather different line of reasoning. According to the 'economic' perception, although peak oil has led to a plateau in *conventional* crude oil production[5] (production may start to decline in the mid-term), there will be no immediate supply gap because declining *conventional* production can be substituted by *unconventional* production from sources such as tar sands, shale oil and (arctic) deep-water oil. According to the World Energy Outlook 2012, until 2035 the net increase of global oil production will be entirely driven by unconventional oil (IEA 2012). This assessment of the IEA is tantamount to the fact that peak oil is imminent. The increasing share of unconventional oil, however, leads to rising production costs which are, amongst other things, due to a less favourable energy return on energy investment[6] (EROEI), and subsequently to higher oil prices (Adams 2009; Farrell and Brandt 2006; Hall 2010: 3; Rubin 2012: 36ff.). In addition to rising production costs, strong demand growth during much of the 2000s may have led to what Hamilton (2008: 12) describes as a 'scarcity rent': "The sharp run-up in price through June 2008 might be consistent with a newly calculated scarcity rent." Hamilton argues that since then scarcity rents may have become a permanent factor in the price of oil.

In principle, the question whether oil prices increase due to a physical gap in cover between supply and demand or due to increasing production costs following the substitution of falling conventional oil production by unconventional oil production is of minor importance for the dissertation topic. Regardless whether oil prices are going to rise due to real physical scarcity, a scarcity rent, or rising production costs, the fact that the global economy is facing a price problem in view of oil remains. According to the World Energy Outlook 2012, average crude oil import prices are going to increase to $125 per barrel (in year 2011-dollars) in 2035 and to $215 in nominal terms. In case Iraq fails to increase its oil supply to world markets, average import prices may increase by another $15 per barrel in year 2011-dollars (IEA 2012). In fact, the decisive factor for the dissertation is that increasing oil price levels may translate into higher transport costs which might translate into economic boom-and-bust-cycles and increasing oil price volatility.

Economic theory suggests that strongly increasing oil prices lead to recessive trends (Hamilton 1983) especially in net oil importing national economies and for the global economy. The recessive trends may then lead to decreasing oil prices since economic shrinking processes reduce oil demand. Low oil prices, however, facilitate economic recovery which in turn involves growing demand for oil. Growing demand for oil translates into yet another round of oil price spikes which again result in (global) recessive trends. As indicated above, repeating boom-and-bust-cycles come along with increasing oil price volatility.

There are already indicators for such boom-and-bust cycles and increasing oil price volatility (Adams 2009). This begs the question to what extent boom-and-bust-cycles, oil price volatility, and increasing international transport costs will eventually impact economic globalisation and long-distance trade.

1.2 Definition of Globalisation

Although ideas of globalisation have an awe-inspiring intellectual ancestry including Lenin, Marx, Mill, Smith, Heckscher and Ohlin or Keynes (Bairoch and Kozul-Wright 1996), the term 'globalisation' only began to be used regularly in the 1980s and 1990s (Bird and Rajan 2001; Bourguignon et al. 2002; O'Rourke and Williamson 2002). Nowadays, globalisation is a catchword used worldwide (James 2002: 1).

However, there is no commonly accepted definition of globalisation. On the contrary, multiple definitions exist. Because the term globalisation as used in the public, political and scientific discourse has multiple meanings, globalisation has become a thoroughly contested subject (Bourguignon et al. 2002; Chase-Dunn et al. 2000; Hooker 1996). According to Giddens (1996) "there are few terms that we use so frequently but which are in fact as poorly conceptualised as globalisation." Therefore, the discourse about globalisation has at times become unobjective and unscientific (Bird and Rajan 2001). As a result, it is sometimes difficult to separate the signals from the noise in the debate on globalisation (Srinivasan 2002). Therefore, it is essential for the sequel of the dissertation to provide an adequate working definition of globalisation.

First, it is necessary to define globalism and to describe the interrelation between globalism and globalisation. Keohane and Nye (2000: 105) define globalism as "a state of the world involving networks of interdependence at multicontinental distances." Globalism can be described as a multidimensional phenomenon with multiple shapes or facets such as military, environmental, social or cultural globalism. The fundamental dimension of globalism for the dissertation, however, is economic globalism.

The link between globalism and globalisation can be described as follows: Globalisation is the process of increasing globalism, thereby determining how 'thick' globalism becomes at any given time (Keohane and Nye 2000: 108). From this angle, globalisation can be defined as "the process by which globalism becomes increasingly thick" (Keohane and Nye 2000: 108). On the contrary, de-globalisation is the process of decreasing globalism, thereby determining how 'thin' globalism becomes at any given time and can therefore be defined as the process by which globalism becomes increasingly thin.

In order to provide a precise and sharp working definition of globalisation, it is necessary to identify its elements. Scholte (2005: 91) lists internationalisation, liberalisation, universalisation, westernisation and supra-territorialisation as elements or characteristics of globalisation. The dissertation focuses on economic internationalisation and liberalisation.

The working definition can therefore be narrowed down by a restriction on economic globalisation parallel to the restriction on economic globalism.

Abdelal and Segal (2007: 103) define economic globalisation as the "worldwide flow of capital, goods, and labour."[7] In this context, the dissertation focuses on the impact of peak oil on worldwide trade flows. Chase-Dunn et al. (2000) define trade globalisation as the extent to which the long-distance and global exchange of commodities increases or decreases relative to the exchange of commodities within national societies. This definition serves as an adequate working definition.

2 Review of the Literature

At least since the oil price shocks in 1973/1979, the macroeconomic effects of oil prices have been studied extensively (Korhonen and Ledyaeva 2010). According to Mirza and Zitouna (2008), "it is well known that oil shocks create many macroeconomic direct and indirect effects on inflation, employment, GDP, real wages and productivity. These have been well studied and documented since the early 1980s. … The impact of oil prices through the cost of transportation and international trade has been little studied though." The dissertation contributes to fill that research gap. Therefore, the literature review gives an overview of the literature that deals with the impact of peak oil or high oil prices on the geography of international trade. On the other hand, the literature review does *not* discuss articles about the impact of oil price shocks on inflation, employment, GDP, real wages or productivity.

The literature describing or analysing the link between peak oil, international transport costs, and trade globalisation provides anecdotal evidence (2.1), descriptive evidence (2.2), and quantitative/econometric evidence (2.3). The final section of the literature review (2.4) summarises and evaluates the findings described in the previous sections.

2.1 Anecdotal Evidence

Between 2006 and 2008, a number of reports described the efforts of companies (e.g. IKEA, Tesla Motors) to readjust their (global) supply chains in response to increasing fuel prices/transport costs (Engardio 2008; Girotti and Kilgore 2006; Hoffman 2008; Mortished 2008; Rohter 2008; UNCTAD 2008; Wood 2008). These reports provide anecdotal rather than quantitative evidence and the examples given are not necessarily representative for the respective industries.

Moreover, Rohter (2008) lists some of the industries most affected by transport cost pressure on international supply chains (furniture, footwear, toys, electronics, food and steel). Furthermore, Fantazzini et al. (2011) and Phillips (2005) point out that high international transport costs act very much like tariffs, thereby impacting long-distance trade volumes.

2.2 Descriptive Evidence

In a series of articles, Curtis (2006a, 2006b, 2007, 2009) and Curtis and Ehrenfeld (2012) argue that peak oil (and global warming) will undermine globalisation based on low transport costs with the consequence of increasing regionalisation and shorter supply chains in many industries (e.g. manufacturing, food production) due to shifting comparative advantages. Curtis and Ehrenfeld stress that initial shifts in transport modes (e.g. from air to ocean transport) in order to reduce fuel costs at the cost of high-speed transport will be followed by more fundamental adaptions to reshape international supply chains at the cost of long-distance trade. The authors exemplarily cite international steel trade. In 2008, U.S. domestic steel production figures increased for the first time after many years of contraction. Some domestic steel mills used iron ore imports from Brazil for steel production, thereby bypassing expensive trans-Pacific iron ore shipments from Brazil to China (upstream trade costs) and expensive steel shipments from China to the U.S. (downstream trade costs).

According to Pellényi et al. (2008), rising oil prices have a direct effect on production costs and transport costs of firms. When increasing transport costs cannot be passed to consumers and cannot be outbalanced by efficiency gains or fuel substitution, companies may change their supply-chain strategies or relocate production. The authors argue that current theories and practices in supply chain management were designed in the 1990s under the assumption of low oil prices which led, amongst other things, to the invention of just-in-time manufacturing strategies where inventories are minimised by smaller, more frequent shipments, and offshore sourcing. In 2007/2008, however, a number of European businesses started to restructure their distribution networks e.g. by transport mode switching to adapt to higher oil prices and to put a stop to rising transport costs. Pellényi et al. stress that structural changes in the global economy such as trade liberalisation, freer movement of capital, technological progress and the reduction of transportation and communication costs allowed markets to become more integrated and enabled the fragmentation of production processes to take advantage of the most cost-effective locations for individual stages in the production process. However, while lower production costs outweighed transportation costs at low oil price levels, this might change with higher oil prices. In addition to providing descriptive evidence, Pellényi et al. also conduct quantitative/econometric research. Their findings are described in section 2.3.

Hall et al. (2006) stress that low energy costs during the latter part of the 20th century conveyed the impression that transportation costs were of limited importance in explaining global supply chains. The authors argue that peak oil will be a strong ‘reality check’ for economic systems that rely on cheap transport through their supply chains. As the costs of maintaining the existing distribution structure are going to increase and comparative advantages will be compromised, a new phase of change in transport and economic geographies may occur. Hall et al. indicate that the crucial question may be whether the current distribution system sowed the seeds of its own end by constantly increasing oil demand in the transport sector or whether the current structure is flexible and adaptable enough to cope with rising transport costs.

Rubin and Tal (2006, 2008) and Rubin (2009, 2012) also argue that high transport cost levels as witnessed in the 2006 to 2008 period will cause a significant reduction of long-distance trade (particularly in U.S.-Chinese trade) in the nearer future. They argue that as a result of peak oil, rising transport costs will in tariff-equivalent terms offset much of the trade liberalisation efforts of previous decades, thereby shortening global supply chains in industries with low value-to-weight ratios. The authors base their claims on the following facts (effective May 2008):

- In May 2008, oil prices accounted for almost 50% of total shipping costs.
- Between 2005 and 2008, every $1 rise in oil prices fed directly into a 1% rise in transport costs.
- In 2000, when oil prices stood at $20 per barrel, transportation costs were the equivalent of a 3% U.S. tariff rate. In May 2008, when average oil prices stood at $125, transport costs were the equivalent of a 9% tariff-rate. With oil prices at $150, the tariff-equivalent rate would be 11%.
- At 2008 oil price levels, every 10% increase in ocean trade distance translated into a 4.5% increase in ocean transportation costs.
- In 2000, at $20 per barrel of oil the cost of shipping a 40-foot container from Shanghai to the U.S. East Coast was $3,000 (including inland costs). In May 2008, at $125 per barrel the cost of shipping a 40-foot container was $8,000 and at $200, the cost might be up to $15,000.
- Producing a ton of steel takes only 1.5 hours of labour input. At 2008 oil price levels, the cost advantage of China over the U.S. was significantly reduced by upstream and downstream transport costs or even reversed. In May 2008, Chinese steel exports to the U.S. were down 20% on a year-over-year basis. At the same time, U.S. domestic steel production was up 10%.
- Goods with a high value-to-freight ratio carry implicitly small transportation costs relative to total costs, while goods with a low value-to-freight ratio carry relatively large transport costs. In 2008, freight-sensitive Chinese exports accounted for 42% of total exports to the U.S. down from 52% in 2004.

Two articles referring to Rubin and Tal (Murphy 2008; The Economist 2008) also discuss the scenario of a reduction of Chinese trade with the U.S. due to high oil price levels. However, the undertone of these articles is more cautious when it comes to the significance of the impact on Chinese-U.S. trade levels. Murphy (2008) argues that falling transport costs resulting from the relocation of production sites from China to countries geographically closer to the U.S. could come at the cost of rising labour costs and less potential for economies of scale. Herold (2012) mainly reproduces the article of Rubin and Tal (2008) and adds some information on the interdependencies of peak oil, transport costs, and globalisation.

Jacoby and Halbert (2007) analyse the impact of the oil price increase during the 2000s on international supply chains. They emphasise that lean supply chains depend on cheap transport to reduce inventory requirements and that lean theory and practice were invented when oil prices where at $25 per barrel. The authors also highlight that fuel surcharges due to rising oil prices increased substantially beginning in 2006, thereby putting pressure on international supply chains. When international transport becomes more expensive, managing just-in-time supply chains becomes more challenging and in many cases slower and cheaper transport modes need to be selected. In the long run, rising and/or volatile oil prices can influence sourcing decisions. Then, remote sourcing locations tend to be substituted by less distant sourcing locations. The authors conclude that the impact of rising oil prices on international supply chains remained limited until the end of 2006 and that the majority of supply chains would not need major realignment until oil prices reach the $100 mark. However, the report was published in January 2007 and therefore does not take into account the dramatic oil price increases between January 2007 and July 2008 when oil prices increased from $50 to $147.

Alexander (2011) describes possible cripple effects as a result of transport cost increases due to peak oil, thereby citing the examples of the global food and steel industries.

Wakeford (2007) points out that trade globalisation is based on abundant, cheap oil fuelling international transport systems. The author expects a partial reverse of the globalisation process (especially in sectors relying heavily on oil-fuelled transport) as a result of peak oil and expects an increase in localised production and consumption. Wakeford also describes possible effects on the South African economy. South Africa exports about 25% of the goods produced (which are transported over long distances to a significant extent) and is therefore characterised as being vulnerable to oil price spikes.

Ralston (2008) stresses that only transport based on cheap oil made possible economic globalisation in its current form. As strongly increasing oil prices make transportation fuel more expensive, long-distance transportation structures are impacted to a significant extent.

According to Friedrichs (2010), globalisation has been fuelled by cheap and abundant energy. Friedrich notes that increasing conflicts over scarce energy may undermine the global economic and political globalisation processes observed in previous decades.

Jen and Bindelli (2008) argue that the East Asian trade model based on cheap transport, cheap labour and vertical specialisation will be significantly impacted by peak oil because the production network requires components to be shipped multiple times thus making affordable transport costs a necessity. The authors also suggest that peak oil may lead to increasing regionalisation at the cost of long-distance trade. Moreover, Jen and Bindelli suggest possible positive effects in the long run such as a reduction of global trade imbalances.

A study of the Centre for Transformation of the German Armed Forces (Bundeswehr Transformation Centre 2010; Schultz 2010) concludes that peak oil might pose a systemic risk for the global economy and for international trade. The study refers to crude oil as an essential determinant of globalisation because oil is the basic source for multiple transportation fuels and therefore a basic requirement for the transport of goods over long distances. The study further characterises cheap international transport as the backbone of globalisation and argues that the international division of work or the extent of vertical specialisation would not be possible without low international transport costs. The possible implications for the German economy are described as extensive because it is one of the most globalised economies by international standards. In a scenario for the global economy, the study forecasts an increase in transport costs at final selling prices and decreasing trade volumes in the short run and the possible collapse of global supply chains in the midterm. Finally, the authors of the study argue that peak oil might pose a systemic risk and that an economic tipping point might lead to a chain reaction that might severly destabilise the global economy. Economies are functional within a band of relative stability where cyclical variation and other shocks can be absorbed while the economy's functional principles lead to recurrent equilibriums within the system. Beyond this band of relative stability, however, the system may react chaotic. The disintegration of complex economic systems including its interdependent infrastructures might trigger such non-linear reactions.

Delbruck (2005) analyses the impact of rising oil prices on New Zealand's economy and concludes that due to the country's geographical isolation, a permanent increase of international fuel prices may raise the price of imported goods and may reduce the competitiveness of export-oriented industries.

A report on behalf of New Zealand's government (NZ Govt 2009) also analyses the link between rapidly rising oil prices and the performance of New Zealand's economy. The report states that the country's level of exposure to positive oil price changes is more acute than for many other countries due to the distance to international markets because high and/or volatile oil prices are immediately felt by primary production exporting sectors with long transport networks to global markets. Exemplarily, the report mentions the export of high-volume commodities like milk and forestry products where transport costs represent a high proportion of overall costs. The report concludes that New Zealand's economy is likely to suffer overproportionally from rising oil prices resulting from peak oil due to its distance to global economic centres.

2.3 Quantitative/Econometric Evidence

Mirza and Zitouna (2009) justifiably criticise the above-cited articles for being too much anecdotal and/or descriptive to allow for valid conclusions about the link between peak oil, international transport costs, and the geography of world trade. The studies providing quantitative or econometric evidence are introduced below.

Guerrero de Lizardi and Padilla-Perez (2010) examine whether North American (Mexico), Central American (Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua), and Caribbean countries (Dominican Republic) profit from peak oil at the cost of remote countries by increasing their export levels to the U.S. as a result of comparatively low transport costs for shipments destined to the United States.

For that purpose, the authors use the MAGIC (Module for the Analysis of Growth in International Commerce) software developed by the United Nations Economic Commission for Latin America and the Caribbean (ECLAC) to analyse countries' market shares in the U.S. market. MAGIC is an analytical tool that contains a database with U.S. import data from the U.S. Department of Commerce from 1990 to the present (The study uses data for the time period between 1990 and 2008.). The methodology applied in MAGIC is based on the Competitive Analysis of Nations (CAN) model which is a single equation model derived from Constant Market Share Analysis (CMSA).[8]

The authors consider product analysis as the best path to explore the development of relative shares in the U.S. import market. The manufactured products selected for analysis (women's beach wear, men's beach wear, men's underwear, fibre optic cables, beer, automatic circuit breakers, orange juice, baseballs, plastics for automobiles, tobacco) were chosen on the basis of two criteria. First, the product analysed registers significant and consistent penetration in the U.S. statistically speaking. Second, there must be an Asian country among the main competitors for U.S. import market share.

In case countries geographically close to the U.S. can increase their market share at the cost of remote countries, the authors expect the statistical relationship between the oil price and the relative price of a product (which is a weighted average of absolute product prices) for the geographically close countries to be negative so that import market shares increase. Based on the estimated elasticity values of the relative price of a product with respect to the oil price, the authors simulate the change in the U.S. import market share for a proximate country resulting from a reduction in the relative price of a product for four oil price scenarios (WTI oil price at \$60, \$90, \$120, \$150). The results for the selected products for each country are summarised in table 2.1. The authors find that for every product analysed, the market share of the countries included in the analysis increases with rising oil prices. For example, when oil prices rise from \$60 to \$150, the Mexican market share in U.S. imports for women`s beachwear increases by 8.1% (men's beach wear: +3.7%; fibre optic cables: +5.4%; beer: +3.7%; automatic circuit breakers: +6.0%; orange juice: +3.7%; plastics for automobiles: +18.8%).

Table 2.1 U.S. Import Market Share in %

Country/Product	U.S. Import Market Share in %*				
	2008	$ 60	$ 90	$ 120	$ 150
MEXICO					
Women's Beach Wear	24.3	23.9	26.6	29.3	32.0
Men's Beach Wear	15.2	15.0	16.2	17.5	18.7
Fibre Optic Cables	47.3	48.5	50.3	52.1	53.9
Beer	44.7	45.5	46.7	48.0	49.2
Automatic Circuit Breakers	-	50.8	53.6	56.3	56.8
Orange Juice	31.2	32.0	33.2	34.5	35.7
Plastics for Automobiles	11.2	15.2	21.4	27.7	34.0
COSTA RICA					
Men's Beach Wear	-	0.1	0.5	0.8	1.2
Men's Underwear	11.7	11.1	14.0	16.9	19.8
Orange Juice	10.2	11.3	13.1	14.8	16.6
Baseballs	18.6	19.5	21.0	22.5	23.9
Plastics for Automobiles	7.2	12.7	21.4	30.1	38.7
El SALVADORE					
Women's Beach Wear	6.3	8.0	10.8	13.6	16.3
Men's Beach Wear	11.2	10.8	13.1	15.5	17.8
Men's Underwear	15.9	16.3	16.9	17.5	18.2
Beer	0.1	0.2	0.3	0.4	0.5
GUATEMALA					
Women's Beach Wear	6.4	6.3	6.7	7.0	7.3
Beer	0.04	0.04	0.04	0.05	0.05
HONDURAS					
Women's Beach Wear	12.8	13.2	13.8	14.5	15.1
Men's Beach Wear	18.7	17.9	22.1	26.3	30.4
Men's Underwear	13.4	13.9	14.6	15.4	16.2
Orange Juice	0.1	0.2	0.2	0.3	0.4
Tobacco	2.0	3.2	5.0	6.9	8.7
NICARAGUA					
Women's Beach Wear	2.9	3.3	4.1	4.8	5.5
Men's Beach Wear	3.3	2.4	7.3	12.2	17.1
Tobacco	2.4	2.6	2.9	3.2	3.5
DOMINICAN REPUBLIC					
Women's Beach Wear	1.1	0.0	6.3	12.5	18.8
Men's Beach Wear	3.0	3.0	3.2	3.4	3.7
Men's Underwear	12.1	12.3	12.6	12.9	13.2
Beer	0.7	0.8	1.0	1.3	1.5
Automatic Circuit Breakers	-	39.7	41.5	43.2	43.2
Tobacco	79.8	80.6	81.9	83.2	84.5

Source: Guerrero de Lizardi and Padilla-Perez (2010)

*2008: real market share; $ 60 -$ 150: simulated market shares

The authors conclude that exports from the countries listed above are likely to increase at the cost of exports from remote countries (e.g. manufactured goods exported from East Asia) when high oil price levels persist in coming years. It is at least questionable whether the findings for the selected goods can be generalised for the 30,000 goods exported from the Central and North American countries to the U.S. as the authors propose.

In a series of papers, Mirza and Zitouna (2008, 2009) and Kousnetzoff, Mirza and Zitouna (2008) study the effect of high oil prices on the geography of international trade.
Mirza and Zitouna (2009) examine the hypothesis that countries are affected differently by high oil prices depending on their geographical location. Thereby, rising oil prices are assumed to distort the relative price of goods which leads to a reallocation of resources across countries with the result of increasing regionalism at the cost of long-distance trade. First, the authors set up a general transport cost function that includes fixed and variable transport costs and take it to the test. They find that, as expected, more distant countries are affected overproportionally by an increase of oil prices relative to geographically close trading partners. By affecting variable transport costs, rising oil prices alter the structure of transport costs among trading partners, thus acting as a factor of distortion in relative prices. This mechanism leads to a reallocation of international trade at the cost of remote countries and fosters regionalism at the expense of trade globalisation.
Second, Mirza and Zitouna use the datasets provided by Feenstra and Hummels containing data on U.S. bilateral imports and transport costs to calculate the elasticity of transport costs to oil prices for the time period 1974-2001[9]. The authors estimate an elasticity of 0.103 for long-distance exporters (more than 10,000km) and an elasticity of 0.088 for close U.S. trading partners (less than 3,000km). Next, they estimate the elasticity of foreign supplier market shares in the U.S. to freight rates to be around 1.12. From there, the authors infer the elasticity of relative market shares to oil prices and find that a 10% increase in oil prices leads to a 0.04% reduction of market shares for distant U.S. trading partners and an increase of market shares of 0.13% for close U.S. trading partners.
Third, the authors apply these elasticities to determine the impact of the 2000s oil price shock on the distribution of U.S. imports between 1999 and 2006. During that period, Mexico`s and Canada`s export shares increased by 2.2% to 3% and India`s and China`s export shares decreased by 0.4% to 0.7%.
Finally, Mirza and Zitouna simulate the impact of the oil shock in the 2000s on the relative probability to export to the U.S. between 1999 and 2006 for different countries. Thereby, the relative probability to export is estimated for a given year (e.g. 2006) by calculating the propensity to export for a given country and then dividing it by the mean probability to export (estimated over the whole sample for that year). The authors find that the probability

to export to the U.S. increased by 4% for Canada and 3.5% for Mexico and decreased by 0.8% for China, 0.6% for Japan and 0.1% for India.

It is noteworthy that the authors did not include the 2007-2008 period in the analysis. During that period, real oil prices reached their highest levels (2007: $72.3; quarters 1-3 in 2008: $113.3) (EIA 2011a; b). Oil prices during the sample period, however, were considerably lower (1999: $19.3; 2000: $30.4; 2001: $26; 2002: $26.2; 2003: $31.1; 2004: $41.5; 2005: $56.6; 2006: $66.1) (EIA 2011a). Therefore, Mira and Zitouna's estimates may have been more pronounced if the 2007-2008 period would have been included in the analysis. Then, the oil price increase during the sample period would have been 7.5 fold (1999-2008) instead of 4.5 fold (1999-2006). In this context, it needs to be mentioned that a neuralgic point might be reached at a given oil price level where the response of international trade flows to rising oil prices may become non-linear. Another point of criticism is that the time period used for the estimation of the elasticities (1974-2001) consists of two sub-periods, one where oil prices reached very high levels (1974-1984) and one where oil prices were low (1985-2001) so that it is possible that both sub-periods level each other out.

In earlier research, Mirza and Zitouna (2008) use the same methodological approach as in Mirza and Zitouna (2009) to estimate that a 1% increase in distance leads to an increase of transportation costs by 0.008% and to simulate the oil price effect on the market shares of countries exporting to the U.S. when oil prices double. The results of the simulation have been summarised in table 2.2 ordered by world regions.

The trends for the different regions are as follows:

- <u>Europe:</u> When oil prices double, the market share of European countries in the U.S. market is reduced marginally by 0.1%-0.2%, is not affected, or increases marginally by 0.1%-0.2% (exceptions: Ireland +0.3%; UK +0.3%; Iceland +0.5%).

- <u>C.I.S.:</u> The market share of C.I.S. countries is reduced by 0.2%-0.3% with the exception of Belarus, Russia and Ukraine which are not affected at all.

- <u>North America:</u> The market share of North American countries in the U.S. market increases significantly by 0.7%-1.6%.

- <u>South America:</u> The market share of South American countries in the U.S. market is not affected (Argentina, Chile, Uruguay) or increases by 0.1%-0.8%.

- <u>Africa:</u> The market share in the U.S. decreases by 0.1%-0.7% for the vast majority of African countries. A small minority of African countries is either not affected or can increase its market share marginally by 0.1%-0.2%

- Middle East: The market share Middle Eastern countries in the U.S. decreases by 0.1%-0.4%.
- Asia: The market share of Asian countriesin the U.S. decreases by 0.2%-0.7%.
- Oceania: The market share in the U.S. is reduced for all Oceanian countries by 0.2%-0.6%.

Table 2.2 Evolution of Market Shares in Response to a doubling in Oil Price

Country	MS Evolution (in %)	Country	MS Evolution (in %)	Country	MS Evolution (in %)	Country	MS Evolution (in %)
EUROPE		C.I.S.		AFRICA		MIDDLE EAST	
Cyprus	-0.2	Tajikistan	-0.3	Mauritius	-0.7	Oman	-0.4
Greece	-0.1	Usbekistan	-0.3	Madagascar	-0.7	UAE	-0.4
Bulgaria	-0.1	Turkmenistan	-0.3	Seychelles	-0.6	Qatar	-0.4
Macedonia	0.0	Kyrgystan	-0.3	Mozambique	-0.6	Bahrain	-0.4
Moldowa	0.0	Azerbaijan	-0.2	South Africa	-0.6	Saudi Arabia	-0.3
Malta	0.0	Armenia	-0.2	Malawi	-0.6	Kuwait	-0.3
Albania	0.0	Kazakhstan	-0.2	Zimbabwe	-0.5	Iran	-0.3
Romania	0.0	Georgia	-0.2	Tanzania	-0.5	Iraq	-0.3
Bosnia	0.0	Ukraine	0.0	Zambia	-0.5	Jordan	-0.2
Hungary	0.0	Russia	0.0	Somalia	-0.5	Israel	-0.2
Croatia	0.0	Belarus	0.0	Kenya	-0.5	Lebanon	-0.2
Slovakia	0.1	NORTH AMERICA		Burundi	-0.5	Syria	-0.2
Italy	0.1	Trinidad and Tobago	0.7	Rwanda	-0.4	Turkey	-0.1
Slovenia	0.1	Barbados	0.7	Uganda	-0.4	ASIA	
Austria	0.1	Greenland	0.8	Djibouti	-0.4	Indonesia	-0.7
Poland	0.1	Saint Kittis Nevis	0.8	Ethiopia	-0.4	Singapore	-0.6
Lithuania	0.1	Netherland Antilles	0.9	Congo (RDC)	-0.4	Malaysia	-0.6
Czech Republic	0.1	Panama	0.9	Sudan	-0.3	Sri Lanka	-0.6
Latvia	0.1	Dominican Republic	1.1	Congo	-0.3	Cambodia	-0.5
Estonia	0.1	Nicaragua	1.1	Central Africa	-0.3	Thailand	-0.5
Switzerland	0.1	Haiti	1.1	Gabon	-0.3	Vietnam	-0.5
Finland	0.1	El Salvador	1.1	Equa-Guinea	-0.3	Burma	-0.5
Germany	0.2	Jamaica	1.2	Chad	-0.3	Laos	-0.5
France	0.2	Honduras	1.2	Cameron	-0.3	Philippines	-0.5
Sweden	0.2	Guatemala	1.2	Egypt	-0.2	India	-0.5
Spain	0.2	Belize	1.3	Nigeria	-0.2	Bangladesh	-0.5
Denmark	0.2	Bermuda	1.3	Benin	-0.2	Hong Kong	-0.4
Benelux	0.2	Mexico	1.4	Togo	-0.2	Nepal	-0.4
Netherlands	0.2	Bahamas	1.4	Ghana	-0.1	Pakistan	-0.4
Norway	0.2	Canada	1.6	Niger	-0.1	Afghanistan	-0.3
Portugal	0.2	SOUTH AMERICA		Cote d'Ivoire	-0.1	China	-0.3
UK	0.3	Uruguay	0.0	Burkina Faso	-0.1	Korea	-0.2
Ireland	0.3	Argentina	0.0	Liberia	0.0	North Korea	-0.2
Iceland	0.5	Chile	0.0	Mali	0.0	Japan	-0.2
		Brazil	0.1	Tunisia	0.0	Mongolia	-0.2
		Paraguay	0.1	Sierra Leone	0.0	OCEANIA	
		Bolivia	0.3	Guinea	0.0	Australia	-0.6
		Peru	0.4	Guinea-Bissau	0.1	Papua New Guinea	-0.5
		Suriname	0.5	Algeria	0.1	New Zealand	-0.4
		Guyana	0.6	Gambia	0.1	New Caledonia	-0.4
		Ecuador	0.7	Senegal	0.1	Fiji	-0.3
		Colombia	0.8	Mauretania	0.1	Kiribati	-0.2
		Venezuela	0.8	Morocco	0.2	Samoa	-0.2

Source: Mirza and Zitouna (2008)

By tendency, countries from regions geographically close to the U.S. (North America, South America) can increase their market shares significantly, while countries from geographically remote regions lose moderately (C.I.S., Middle East) or significantly (Asia, Oceania). The effect of doubling oil prices on the market share of European countries to the U.S. is almost neutral.

Although the figures in table 2.2 do not seem to be dramatic at first glance, the authors argue that the sextuple increase of oil prices between 1999 and the first quarter of 2008 would have non-negligibly increased North American trade. In this scenario, the oil price shock during the 2000s would have led to an increase of Canada`s and Mexico`s sum of market shares by almost 7.5%. The authors conclude that the very large shift of oil prices during the 1998-2008 period seems to have acted as an endogenous factor stimulating the regionalisation of trade flows.

Finally, it should be mentioned that the estimates for some countries are quite surprising when compared with other countries. Take the estimates for Asian countries for example. Is it realistic that in reaction to doubling oil prices the market share of the modern economies of Singapore and Malaysia decreases by 0.6% and the market share of China decreases by 0.3% while the market share of Mongolia and North Korea (Do North Korea and the U.S. trade at all?) only decreases by 0.2%?

In another study, Kousnetzoff, Mirza and Zitouna (2008) find that due to the 7.5-fold increase in oil prices between 1998 and 2008, the volume of goods transported to the U.S. by air decreased by 12.3%, thereby slowing the mobility of goods traded. Moreover, they find an increase of 3.1% in the per-ton value of goods exported to the U.S. and an increase of 4.1% of Canada's and Mexico's respective market share for exports to the U.S.

With regard to the methodology applied, the authors emphasise that econometric analysis has been used to generate the estimates described above and refer the reader to Mirza and Zitouna (2009) for more details. Therefore, it can be assumed that the same methodological approach as in Mirza and Zitouna (2009) has been used.

A series of articles by Ma and Van Assche (2010) and by Gangnes, Ma and Van Assche (2011a, b) examine the impact of peak oil or high oil prices on the sensitivity of distance to international trade.

Ma and Van Assche (2010) use data from the Chinese processing trade regime for the 1988-2008 period to examine the impact of peak oil on global production networks (GPN). The authors use an augmented gravity model which is a generalised version of the model invented by Ma et al. (2009) to test two hypotheses.

The first hypothesis tested is that ceteris paribus, rising oil prices increase the sensitivity of Chinese processing exports to import and export distance. The estimated coefficients are negative and statistically significant suggesting that oil price spikes indeed make Chinese processing exports more sensitive to upstream and downstream trade distance.

The second hypothesis tested is that ceteris paribus, oil price shocks reduce China's share of processing exports in total exports, especially for distant destinations. The estimated coefficients indeed suggest that increasing oil prices reduce the share of China's processing exports in total exports for far away destinations.

The findings are in line with Yi`s (2003) theoretical prediction that inter-GPN trade is more sensitive to changing trade costs than regular trade.

In later research, Gangnes, Ma and Van Assche (2011a, b) examine the impact of oil price spikes on global trade, particularly within GPNs. The authors estimate a set of gravity models on a panel dataset from China Customs Statistics which includes data on trade by customs regime (processing trade vs. regular trade) and by transport mode (air transport vs. maritime transport) for the 1988-2008 time period. That is, they use the same dataset as Ma and Van Assche (2010).

The authors find that Chinese exports become more sensitive to distance when oil prices spike. They also find that this effect is more pronounced for processing exports where goods cross borders multiple times. Finally, Gangnes et al. find that goods transported by air are less vulnerable to the effects described above. The authors explain the difference with the high value-to-weight ratio of goods transported by air and with the relatively greater importance of factors other than transport costs such as timeliness. The latter finding partially contrasts the estimates of Kousnetzoff et al. (2008).

Although the estimates of Gangnes et al. are statistically significant, their economic effects remain relatively small. For the 2002-2008 period when oil prices quadrupled, the authors estimate an increase in the elasticity of Chinese exports to distance of 5%-7%. They also estimate the impact of an oil price spike from \$26 to \$100 depending on the type of trade (processing vs. non-processing) and transport mode and find that in air-intensive industries, distance elasticity increases by 0.02 to 0.03 per cent points for processing and non-processing exports respectively. The effect is more pronounced in non-air-intensive industries where the distance elasticity increases by 0.13 per cent points for processing exports and by 0.09 per cent points for non-processing exports.

The authors admit that their study is subject to significant limitations resulting from the time period used and the empirical specification employed. They point out that oil prices remained low during the first half of the sample period making it difficult to precisely compute oil price effects. This statement leaves the reader wondering why the sample has not been narrowed down to the period of the oil price spike between 1998 and 2008. Moreover, Gangnes et al. point out the difficulty to separate the impact of oil prices from other time-varying factors. Finally, the specification used imposes constant elasticities of the distance effect with respect to the price of oil which may not be an appropriate assumption.

Lutz and Meyer (2009) analyse the impact of high/rising oil prices on German trade volumes, thereby using the INFORGE (INterindustry FORecasting GErmany) and GINFORS (Global INterindustry FORecasting System) models which are described as structural econometric models or econometric input-output models. More precisely, INFORGE is described as an econometric input-output model owing to the econometric calculation of its parameters and to existing input-output connections. The model disaggregates the German economy into 59 industries. GINFORS is a bilateral trade model which is designed to depict the economies of 50 countries and two regions (OPEC and the Rest of the World) in structural detail and links them by using bilateral trade data for 25 commodities and 1 service good.
In the baseline scenario, oil prices are at \$80 in 2010 and increase to \$100 in 2020. Lutz and Meyer find that German exports increase by 0.3% as a reaction to the increase in oil prices. The increase of exports is mainly due to high trade shares in oil exporting countries which increase spending when oil prices rise and to the country’s strong investment goods industry. Thereby, the increase in exports is mainly due to rising machinery, motor vehicle, radio, TV and communication equipment exports. However, the authors point out that Germany is among the countries with the lowest oil vulnerability index worldwide and that the impact on other economies which are more vulnerable to rising oil prices is likely to be negative.

Lehr et al. (2011) research the macroeconomic effects of peak oil on national economies by using a ‘peak oil scenario’ and publish results for the German economy. Like Lutz and Meyer (2009), Lehr et al. (2011) also use the GINFORS model described above for their analysis. They describe the model as a ‘sectorally disaggregated global energy-environment-economy model’ combining econometric-statistical analysis with input-output analysis.
The authors estimate a reduction of German exports by 5.5% and a reduction of imports by 15.9%. Lehr et al. state that the effect on the German economy might be low relative to other economies due to the high-quality goods produced for which transportation costs are relatively less important. Moreover, the proximity to export markets might dampen the effect of peak oil while remote countries such as Japan may be affected overproportionally. More generally, Lehr et al. state that the transport industry will be affected in the first place while indirect effects will be felt along global supply chains.

However, the above-cited results were estimated based on scenarios where oil prices increase to \$400 and/or \$600 by 2020 at constant prices which seems quite excessive. The authors also stress that the estimates should be interpreted with care as the oil price levels assumed in the scenarios have never been experienced before. Finally, Lehr et al. emphasise that even small changes in the parameters of the GINFORS model could alter the results substantially.

Pellényi et al. (2008) simulate shifts in international trade patterns as a result of increasing oil prices. They use the global simulation model (GSIM) designed by Francis and Hall (2003) for the purpose of analysing global, regional, and unilateral trade policy changes. The authors describe the model as a multi-region, imperfect substitutes model of world trade that employs a partial equilibrium approach in which sectoral effects are not considered.

The simulation of changing trade patterns is based on the assumption of the existence of a specific set of changes to import tariffs which, in its effect on trade flows, is equivalent to a change in the price of oil. In other words, Pellényi et al. introduce equivalent ad valorem tariff rate changes which shall simulate the effects of an assumed increase in oil prices from 25€ to 60€ for the EU, the U.S., China, Japan, and 'the rest of the world' (ROW).

The simulation results indicate that as a consequence of the oil price increase, EU exporters face the equivalent of an additional tariff rate of 1.6%. Moreover, exporters from the other countries/regions analysed are faced with the following additional tariff rates: U.S.: 2.9%, Japan: 1.7%, China: 6.6%, rest of the world: 3.2%.

The other results of the simulation are presented in table 2.3 where the figures on the diagonal represent the estimated changes in domestic output and the figures off the diagonal represent the estimated changes in bilateral trade flows. Thereby, it is remarkable that China, which is widely regarded as an economic powerhouse, faces the biggest losses in terms of bilateral trade flows (bilateral trade trade flows with the EU: -10.4%; USA: -8.4%; Japan: -9.9%; ROW: -6.5%) compared to the other countries/regions analysed. On the other hand, the EU and Japan increase their exports or loose only slightly, while the U.S. increases its exports or looses moderately.

Table 2.3 Simulated Effects of an Oil Price Shock on Bilateral Trade Flows (in %)

Origin	Oil price shifts from EUR 25 to EUR 60 per barrel Destination				
	EU	USA	Japan	China	ROW
EU	**-1.1**	0.9	-0.8	6.4	1.1
USA	-3.6	**-1.9**	-2.9	4.3	-1.6
Japan	-0.9	0.9	**-1.1**	6.5	1.1
China	-10.4	-8.4	-9.9	**-4.5**	-6.5
ROW	-4.4	-2.6	-4.1	3.5	**-2.0**

Note: ROW = Rest of world Source: Pellényi et al. 2008

At an oil price of $30 per barrel, sourcing goods from China by U.S. firms leads to average net final cost savings of 18% while bunker fuel costs make up about 4% of final selling prices. Based on these figures, Pellényi et al. calculate that sourcing/importing from China becomes uneconomic for U.S. firms once oil prices reach $165 per barrel.

Chen and Hsu (2012) examine the impact of high oil price volatility[10] on trade globalisation. That is, the authors' focus is not primarily on high oil price levels but on the fluctuation of oil prices. Chen and Hsu argue that peak oil may lead to increasing oil price levels *and* increasing oil price volatility due to economic boom-and-bust cycles. As a result, international trade is not only impacted by high oil prices through the transport cost channel but also through the uncertainty channel as a result of oil price volatility. For instance, oil price volatility may prompt consumers to postpone purchases or companies to postpone irreversible investments (for example in geographically remote countries). The reduction of domestic consumption and investment expenditures may lead to a reduction of aggregate demand and may therefore reduce international trade.

The authors use annual data from 1984 to 2008 for 84 countries on international trade and the structural VAR model with new identification assumptions proposed by Kilian (2009) for their analysis.

Chen and Hsu find a negative and statistically significant relationship between oil price volatility and international trade. The relationship is robust to different oil price volatility measures. They also find that oil supply shocks discourage trade while oil demand shocks may also provide positive impulses to trade. The latter finding, however, is statistically insignificant. Moreover, the authors find that oil price volatility significantly reduces trade volumes of net oil importers (both imports and exports) while the impact is statistically insignificant (the impact on imports is positive but insignificant; the impact on exports is mixed but insignificant) for net oil exporters. Chen and Hsu conclude that oil price volatility has a significant adverse impact on trade globalisation and may lead to deglobalisation.

Motivated by soaring crude oil prices during the 2000s and their potential implications for trade globalisation, Beverelli (2010) uses single regression analysis or single OLS and IV-GMM regressions to examine whether – and to what extent – maritime freight rates in the container, dry bulk, and tanker trades are affected by variation in bunker fuel prices, thereby using Brent crude oil prices as a proxy for bunker fuel.

First, Beverelli estimates the elasticity of oil prices on maritime freight rates to be 0.40. Next, Beverelli finds that a 10% increase in Brent oil prices leads to an increase of container freight rates between 1.9% and 3.6%. That is, the estimated elasticity is between 0.19 and 0.36. Similarly, a 10% increase in Brent prices leads to an increase in oil tanker freight rates of 2.8%. Finally, a 10% increase in Brent oil prices leads to an increase of iron ore freight rates between 8.9% and 10.5%.

This essentially means that steel producers in countries with iron ore scarcity are facing a considerable disadvantage when compared to steel producers in countries with iron ore abundance. In this context, the author points out that demand for iron ore is relatively inelastic due to the limited potential for substitution by other minerals and its importance as major input in the steel production process. Moreover, finding more proximate locations for iron ore sourcing may prove to be difficult since the iron ore market is dominated by two countries, Australia and Brazil.

Beverelli also emphasises that the impact of rising transportation costs resulting from increasing oil prices may vary among the type and value of goods shipped. For example, transport costs are generally more important for low-value goods than for high-value goods due to the higher share of transport costs to final selling prices. Furthermore, the author emphasises that especially the trade flows and patterns of developing and landlocked countries, which already face transport costs above average, may be at risk.

Korhonen and Ledyaeva (2010) study the impact of oil price shocks on oil-producing and oil-consuming economies. For that purpose, the authors use quarterly data for oil producing/exporting Russia and its main trading partners (Germany, Italy, the Netherlands, China, USA, UK, Switzerland, Finland) for the 1995-2006 period and utilise the methodology invented by Abeysinghe (1998; 2001) where the oil price is treated as an exogenous variable. However, in Abeysinghe's structural VAR model, the growth rates of the countries analysed do not only depend on changes in the price of oil but also on other countries' growth rates via a bilateral export matrix. The rationale behind this model set up is that higher growth rates in one country increases other countries` exports to that country. The model focuses on two types of cross-country linkages, direct effects due to bilateral trade and indirect effects via output multipliers. That is, the trade linkages are used for the estimation of multiplier effects of a shock as it is transmitted through the output fluctuations of other countries.

The authors find that oil exporting countries profit from oil price shocks due to higher oil revenues but at the same time, their exports to oil importing countries are reduced because demand for goods in oil importing countries decreases. On the other hand, other countries are able to increase their exports to the oil exporting countries because of the increasing revenues of oil exporters following an oil price shock.

Because standard trade models have not been able to deliver the result that tariff reductions are responsible for postwar trade growth (The models fail to deliver both the magnitude and pattern of trade expansion.), Bridgman (2008) uses a vertical specialisation trade model to analyse the role of transport costs for trade growth. More precisely, the author describes the model as a 'tractable general equilibrium model with Ricardian trade in intermediate goods'. Model building is based on the following assumptions:

1. Transport costs are quantitatively important.
2. Energy is an important input to transportation.
3. Energy is difficult to substitute away from.
4. Higher energy costs are associated with higher transportation costs.

Bridgman compares postwar trade expansion data between 1960 and 2005 with the estimates generated by the simulated trade model. After rising rapidly in the late 1960s, the estimated model trade shares indicate no sustained growth for the period from 1974 to 1985. Trade growth then increases rapidly after 1985 while both model and data trade growth slows in the 2000s. That is, postwar trade growth increases significantly during periods where oil prices are low (late 1960s, 1985-2000) and slows down significantly in periods where oil prices increase (1974-1985, much of the 2000s). Bridgman concludes that oil price shocks have significant effects on trade growth. He also points out that when oil price levels during much of the 2000s are sustained, international trade may suffer in the near future.

Abu-Bader and Abu-Qarn (2006, 2010) test for structural breaks in the trade ratios (imports/GDP and exports/GDP) of 59 countries during the post-war period (1948-1993), thereby using the Vogelsang (1997) test. The Vogelsang test for detecting shifts in the trend function of a dynamic time series can also be used for trending and unit root regressors.

The authors' goal is to determine whether trade liberalisation or the oil price shocks in 1973/79 are responsible for the detected structural breaks. They find that the majority of the breaks detected for the sample of 59 countries occurred between 1973 and 1981. During this period of time, Abu-Bader and Abu-Qarn detect 24 significant breaks (55% of the total significant breaks) in import ratios and 24 significant breaks (64% of the total significant breaks) in export ratios. Due to the different country specifics, it is rather unlikely that the structural breaks exactly match with the occurrence of the oil shocks should they be responsible for the shift in the ratios. However, even if the time period under consideration is narrowed down to 1973/74 and 1979/80, a considerable number of structural breaks detected occurred during that period (import ratios: 14 breaks or 32% of the total significant breaks; export ratios: 12 breaks or 33% of the total significant breaks). Moreover, for many of the countries included in the analysis the averages of actual post-break ratios are below the averages of the extrapolated pre-break ratios.

The authors therefore conclude that the 1973/1979 oil shocks account for most of the structural breaks in the trade ratios. Two possible explanations for these findings may be reduced demand for internationally traded goods due to the recessions following the shocks or a reduction of international trade due to increasing transport costs.

Bergin and Glick (2007) measure the degree of global commodity price convergence - which serves as an indicator for global economic integration - between 1990 and 2005. The authors use data on prices for 101 tradeable commodities in 108 cities in 70 countries for their analysis. First, Bergin and Glick compute mean squared error (MSE) measures of price dispersion across all country pairs for any of the 101 product categories.
They find a U-shaped pattern of commodity price convergence/dispersion for several sub-groupings of countries, selected regions, and selected commodity groups. Prices converge from 1990 to 1997 and then disperse from 1998 to 2005. After estimating gravity regressions by using the gravity model, Bergin and Glick find that this time-varying pattern coincides remarkably well with oil price fluctuations (in other words: rising oil prices in the second half of the sample period reversed some of the convergence gains in the first half of the sample) and that high oil prices have an influence on price dispersion by increasing price wedges with growing distance.[11]
The results indicate that rising oil prices (the oil price variable is highly significant) have an impact on global price dispersion via the transport cost channel and that the rising price of oil during the 2000s led to an increase of the sensitivity of distance to trade. The results might have been even more pronounced if the 2006-2008 time period would have been included in the analysis.

Finally, a survey of Industry Directions (2007) conducted in 2006 finds that at that time, high oil prices forced manufacturing companies to think about adaptions in their supply chains. Of the 139 manufacturing executives participating in the study, 78% stated that their companies increasingly focused on their supply chains as a consequence of higher oil prices and 70% stated that they were planning to adapt their supply chain strategy. Another 22% of the respondents acknowledged that oil prices might reduce their margins.

2.4 Summary

The literature reviewed in sections 2.1 and 2.2 provides anecdotal and/or descriptive evidence. The explanatory power of such evidence is limited. On the contrary, the literature reviewed in section 2.3 provides quantitative or econometric evidence. The quantitative/econometric evidence in the literature indicates a significant impact of rising oil prices on the sensitivity of international trade to distance during the 2000s.
The effect might have been even stronger if the oil price shock would have been entirely supply-driven. The reason for this lies in the different nature of supply-driven and demand-driven oil price shocks which might affect long-distance trade differently (Fukunaga et al.

2009; Kilian 2009; The Economist 2012). Fukunaga et al. (2009) argue that the oil price surge between 2002 and 2008 might have had a relatively smaller effect on real economic activity and on the structure of international trade compared to the oil price shocks in the 1970s, because it was not entirely supply-driven (such as peak oil) but also demand-driven. Second, some analyses (e.g. Mirza and Zitouna 2009: 1999-2006; Bergin and Glick 2007: 1990-2005) do not include the whole period of oil price increases in their studies. This may have influenced some estimates because the most significant oil price increase occurred between January 2007 and July 2008 when oil prices rose from $50 per barrel to $147 per barrel.

Recapitulatory, irrespective of the different methodological approaches used (such as VAR and gravity modelling, vertical specialisation trade models, GINFORS, INFORGE, GSIM, MAGIC), the studies reviewed all provide evidence for a link between oil prices, international transport costs and the geography of international trade. In this context, the literature indicates an adverse effect of rising oil prices on global supply chains and long-distance trade through the transport cost channel.

Despite the potential importance of the link between persisting high oil price levels and the geography of world trade, which is indicated by a growing body of literature in recent years, so far remarkably little research has been conducted for that matter. Particularly, there is a gap in the literature with regard to the impact of rising oil prices during the 2000s on international trade volumes and the shape of international trade at the industry level. Thereby, it would be particularly interesting to study industries whose sensitivity on the distance of trade is likely to be overproportionally affected by high oil price levels, for instance industries producing products with low value-to-weight and/or low value-to-freight-cost ratios such as the steel industry. The dissertation contributes to filling that gap. From a methodological point of view, the vector error correction (VEC) model used also contributes to the existing literature because this methodological approach has not yet been applied for analysing the importance of the link between rising oil prices, transport costs and the geography of world trade. The selection of the VEC model is justified in section 5.1 of the methodology chapter.

3 Analysis I: Oil Prices, International Transport Costs and Trade Globalisation

Chapter 3 provides the knowledge base about the basic fundamentals underlying the analysis of the econometric estimates in chapter 6 to give the reader essential background information.

The hypothesis tested in chapter 6 by using the example of steel exports to the U.S. is that peak oil, which involves high oil prices and rising international transport costs, leads to an increasing regionalisation of international trade flows at the cost of long-distance trade.

It is assumed that rising oil prices influence the shape of international trade via the transport cost channel. Therefore, section 3.1 gives an overview of the literature analysing the responsiveness of international trade to transport costs and the relative importance of transport costs as a barrier to international trade.

Steel is almost exclusively shipped via ocean. Therefore, section 3.2 first describes the progression of ocean transport costs over time and then describes the working mechanism of the ocean transport cost channel. More specifically, the relationship between oil prices, fuel costs, ocean transport costs and international trade is explained.

In chapter 6, evaluation criteria, among them determinants of ocean transport costs, are used for the interpretation of the econometric estimates. The evaluation criteria selected are ocean trade distances, port infrastructure, and economies of scale. Section 3.3 gives an overview of the literature analysing the role of these criteria in determining ocean transport costs.

3.1 Transport Costs as a Determinant of International Trade

Section 3.1 is structured as follows: Section 3.1.1 first describes the responsiveness of international trade to transport costs. Section 3.1.2 then outlines that international transport costs act very much like tariffs and that nowadays transport costs tend to outbalance tariffs as a barrier to international trade. Section 3.1 therefore provides background knowledge regarding the role of transport costs in international trade.

3.1.1 The Responsiveness of International Trade to Transport Costs

Trade liberalisation and declining transport costs top the list of usual suspects when it comes to the causes of post Second World War trade growth (Hummels 1999b; 2007b). Behar and Venables (2010: 2) emphasise that "transport costs shape trade, and are in turn determined by underlying variables such as distance and other features of geography, infrastructure quality, trade facilitation measures, fuel costs and transport technology." However, despite the importance of transport costs for the growth of international trade, there are comparatively few studies on the relationship between transport costs and trade growth (Clark et al. 2002).

Limao and Venables (2001) analyse the quantitative importance of transportation costs as a determinant of trade flows. They find that the elasticity of trade flows with regard to the transport variable is -2 to -3.5. According to Limao and Venables (2001: 466), "taking a value of -3 means that doubling transport costs from their median value (that is, raising the transport cost factor from 1.28 to 1.56) reduces trade volumes by 45%. Moving from the median value of transport costs to the 75th percentile (transport cost factor 1.83) cuts trade volumes by two-thirds."

Baier and Bergstrand (2001) estimate the relative importance of determinants for international trade growth between 1958 and 1988 for 16 OECD countries. The authors find that income growth accounts for 66% of trade growth and that 26% of trade growth is due to trade liberalisation. Only 8% of trade growth can be attributed to *decreasing* transport costs. However, the assumption that falling transport costs did not contribute to a large extent to the growth of trade in the second half of the 20th century does not necessarily mean that significantly *increasing* transport costs do not have a significant impact on international trade growth in the 21st century.

Radelet and Sachs (1998) find that increasing transport costs can account for reduced growth rates of manufactured imports. They also find that the doubling of shipping costs (e.g. from an 8% to 16% c.i.f. band) leads to a reduction of annual import growth of slightly more than one-half of a percentage point.

Despite the small number of studies dealing with the impact of international transport costs on trade growth, there is common sense in the literature that transport costs are a trade barrier which can have a significant impact on the volume and the patterns of international trade (Anderson and van Wincoop 2003; Behar and Venables 2010; Clark et al. 2002; Fink et al. 2002; Golub and Tomasik 2008; Hesse and Rodrigue 2004; Kumar and Hoffmann 2002; Lundgren 1996; Quinet and Vickerman 2004; Tanaka 2010; Thompson 2000).

3.1.2 The Relative Importance of Trade Barriers: Transport Costs vs. Tariffs

In order to measure their relative importance as a trade barrier, transport costs can be compared to other trade barriers, particularly tariffs. Comparing transport costs with tariffs is reasonable, because the impact of transport cost reductions on trade is equivalent to the impact of lower tariffs (Kumar and Hoffmann 2002: 45). According to Thompson (2000: 1),

"price in the exporting country multiplied by the exchange rate, plus the transportation cost times one, plus the tariff rate, equals price in the importing country. In trade, we always talk about the possibility of having prohibitive tariffs and what an impediment the tariff wedge can be to international trade. But if you look at this equation, the transportation cost is just as significant as the import tariff so that high transportation costs can work against the trade flows in exactly the same way as high tariffs."

However, international economic analysis regularly used to neglect the effects of transport costs as a trade barrier due to the presumption that the role of transport costs in impeding trade is relatively small when compared to other trade barriers such as tariffs (Finger and Yeats 1976; Sampson and Yeats 1977). As a consequence, in contrast to the large existing body of literature regarding theoretical and empirical consideration of protection by tariffs, studies researching transportation costs as a trade barrier are comparatively rare (Conlon 1982; Laussel and Raymond 2006).

The GATT negotiations led to a constant reduction of tariff rates over time. As a result, worldwide average import tariffs were reduced from 8.6% to 3.2% between 1960 and 1995. In case of the average tariff rate on U.S. imports, there was a cutback from 6.0% to 1.5% since negotiations started in 1950[12] (Clemens and Williamson 2002; Hummels 2007a).

While tariffs have become a less significant trade barrier over time, the relative importance of transport costs to total trade costs has grown (Amjadi and Yeats 1995; Clark et al. 2002; Hummels 2007b; Radelet and Sachs 1998). Studies examining customs data consistently find that transport costs post a trade barrier at least as large as, and frequently larger than tariffs (Hummels 2007b). In 1958, transport costs for the median good were half as much as tariff duties on steel exports to the U.S. (Waters 1970) and, according to Finger and Yeats (1976), equal to tariff duties in 1965.[13] In recent decades, however, papers that have directly investigated the relative importance of transport cost barriers versus tariff barriers have consistently identified transport costs as the more important barrier to trade (Hummels 1999b).

Fink et al. (2002) stress that the average impact of transport costs on imports exceeds the impact of tariffs for the majority of U.S. trading partners. Similarly, Limao and Venables (2001) and Clark et al. (2002) point out that as trade liberalisation has significantly reduced artificial trade barriers, the effective rate of protection provided by transport costs is now, in many cases, considerably higher than that provided by tariffs. For example, transport costs for Latin American countries like Chile and Ecuador exceed by more than twenty times the average tariffs they face in the U.S. market (Clark et al. 2002).

Especially between 2000 and 2008, there has been a rapid increase in the transport cost-tariff balance in favour of transportation costs as a result of constantly increasing crude oil prices. According to Hummels (2007b), in 2004 aggregate expenditures on shipping for total U.S. imports were already three times higher than aggregate duties paid. For the median individual shipments to the U.S. in 2004, exporters paid $9 in transportation costs for every $1 they paid in tariff duties. In May 2008, when oil prices were well above the $100 mark, Rubin and Tal (2008) emphasised that rising crude prices impacted international transport costs at an unprecedented rate and that in tariff-equivalent terms, rising transport costs offset the liberalisation efforts of the last three decades. Furthermore, Rubin and Tal argue that in

2000 when oil prices were at $20 per barrel, transportation costs were the equivalent of a 3% U.S. tariff rate. In Mai 2008 at $125 per barrel, transport costs were the equivalent to a tariff rate of more than 9%. At $150 per barrel of oil, the tariff-equivalent rate is at 11% and can be compared to average tariff rates in the 1970s and at $200, transport costs would be back at a level equivalent to tariffs prior to the Kennedy Round GATT negotiation in the mid-1960s.

3.2 Ocean Transport Costs and International Trade

Steel is almost exclusively shipped via ocean. Section 3.2 therefore focuses on the development of ocean transport costs over time (3.2.1) and on the description of the working mechanism of the ocean transport cost channel (3.2.2).

3.2.1 Ocean Transport Costs over Time

Studies providing systemic evidence on the development of ocean transport costs since the 1950s are surprisingly rare (Hummels 1999b; 2007a). Golub and Tomasik (2008) emphasise that despite the importance of transportation costs as a factor conditioning economic growth and trade growth, there have been few attempts to estimate transport costs over time.

Radelet and Sachs (1998) report falling ocean transport costs over time while Lundgren (1996) refers to almost constantly decreasing costs for 120 years. With regard to bulk shipping transport costs, Lundgren reports that freight rates declined by 65-70% between 1950 and 1995.[14] Chasomeris (2007) refers to declining relative shares of worldwide international transport costs over time (cif/fob ratio: 7.8% in 1970; 6.6% in 1980; 5.2% in 1990).

Hummels (2007b) provides the most comprehensive study on ocean transport cost developments over time (Findlay and O'Rourke 2001) by using ad valorem datasets containing comparably high-quality data. He finds that prices for ocean transport changed little from 1950 to 1970 and increased substantially between 1973 and 1985, followed by a steady decline until the early 2000s. According to Hummels (2007b), it was only when crude oil prices began to drop in the mid-1980s that ocean shipping costs really began to decrease. Similarly, Stopford (2009: 89) reports steadily falling freight rates for the cost of transporting commodities by ship from the mid-1980s until 2004.[15]

Although the exact extent of transport cost reductions during the second wave of globalisation (see 7.5.1) may be debatable (Kumar and Hoffmann 2002: 42), it can be said that even if they did not fall as dramatically as they did during the 19th century, they remained low for most of the 1950-2000 period (Bordo et al. 1999) with the exception of the 1970-1985 period and fell dramatically during the 1985-2000 period.

Lundgren (1996) regards this trend as an important prerequisite for an expansion of global trade with low-valued goods like coal and ores. At the turn of the century, Radelet and Sachs

(1998) argued that maritime transport costs are much less of a barrier to international trade and a greater division of labour than they once were and that there would be reasons to believe that shipping costs will continue to fall in the future. According to Hummels (2007b: 152), however, the contrary is true for 2000-2008: “Indeed, ocean freight costs in recent years have again begun to increase with the cost of crude.”

3.2.2 Oil Prices, Ocean Fuel Costs, the Ocean Transport Cost Channel and International Trade

Stopford (2009) classifies ocean transport costs into five categories: operating costs, periodic maintenance costs, cargo-handling costs, capital costs, and voyage costs.[16] Voyage costs can be defined as “variable costs associated with a specific voyage” (Stopford 2009: 221) and consist of the following sub-components (Stopford 2009: 232f.):

$$VC_{tm} = FC_{tm} + PD_{tm} + TP_{tm} + CD_{tm}$$

where

VC	=	voyage costs
FC	=	fuel costs
PD	=	port and light dues
TP	=	tugs and pilotage
CD	=	canal dues
tm	=	ton-miles

The most significant voyage cost sub-component are bunker fuel costs.[17] Ocean fuel costs can have a substantial impact on freight rates and the shape of international maritime trade. Section 3.2.2 proceeds as follows: Section 3.2.2.1 analyses the relationship between oil prices and ocean fuel costs. Section 3.2.2.2 then describes the relationship between oil prices and ocean fuel costs over time. Finally, section 3.2.2.3 defines the relationship between the ocean transport cost channel, international trade and long-distance trade volumes.

3.2.2.1 The Oil Price – Ocean Fuel Cost Relationship

Ocean transport depends on crude oil-based fuels which remain the main source of fuel propelling the ocean shipping fleet. Therefore, the industry is affected by oil price spikes (UNCTAD 2008, 2009). Shocks to the worldwide demand for and supply of crude oil have an effect on ocean transport fuel prices. Hummels (2007b) finds an elasticity of maritime transport costs with respect to fuel costs of 0.33.

During the sample period used in this study (1998-2008), the impact of sharply increasing oil prices on bunker fuel costs has been strongest between 2002 and 2008 (Hummels 2009). Between 2005 and 2008 every one dollar rise in oil prices directly fed into a 1% rise in transportation costs via the fuel cost channel (Rubin and Tal 2008). In 2007/2008, most industries were affected by the impact of rising fuel costs but the ocean transport industry was hit particularly hard[18] (WSC 2008). When oil prices went up from $30 in 2003 to $100 in January 2007, the average daily fuel bill of a cargo vessel increased from $9,500 to $32,000 (Smith 2009). At 2008 oil price levels every 10% increase in shipping distance translated into a 4.5% increase of ocean transport costs (Rubin and Tal 2008). In May 2008, shipping companies were struggling worldwide when oil prices exceeded the $120 mark, thereby pushing bunker fuel prices to $552 per ton, a $26 per ton increase compared with March 2008 and a relative increase of 87% since January 2007 (WSC 2008). Between 2002 and 2008, ocean fuel costs increased by a total of 500% (Wilson 2008).

According to Behar and Venables (2010), the relative share of fuel costs at total ship operating costs can make up between 40% and 63% depending on ship size.[19] In May 2008, the World Shipping Council reported that fuel costs represented as much as 50-60% of total ship operating costs, depending on the type of ship and service[20] (WSC 2008) .

3.2.2.2 The Oil Price – Fuel Cost Relationship Over Time

Pressure put on the ocean transport industry by rising crude oil prices is not a new phenomenon. Behar and Venables (2010) and Hummels (2007b) emphasise that rising fuel costs resulting from the oil price shocks in 1973 and 1979 also had an upward effect on transportation costs in the 1970s. Between 1973 and 1974, maritime transport costs increased four-fold in real terms (Hummels 2007b). Du Jonchay (1978: 51) estimates that the relative share of fuel costs for a 25,000dwt bulk carrier tripled from 10% to 29% between 1970 and 1975. This increase was to a significant extent due to the 1973 oil price shock (see table 3.1).

Table 3.1 Fuel Costs as % of Operating Expenses

	Oil Tanker (200,000 dwt)	Bulk Carrier (25,000 dwt)	Container Ship Australia-Far East type	Regular-Line Freighter (16,000 dwt)
1970	14%	10%	17%	8%
1975	37%	29%	40%	22.5%

Source: du Jonchay 1978: 51

According to Stopford (2009: 233), fuel prices increased by 950% during the 1970-1985 period. Leaving aside improvements in fuel efficiency, fuel accounted for about 13% of total shipping costs in 1970, a figure that increased to 34% by 1985.

The 1970-1985 ocean fuel price increase had a negative impact on international trade. Ocean trade volumes declined by 6% between 1974 and 1975 and by 15% between 1970 and 1983 (Stopford 2009: 38).

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3.2.2.3 International Trade and the Ocean Transport Cost Channel

The impact of oil prices on international trade in general and particularly on long-distance trade volumes translates via fuel prices through the transport cost channel (Behar and Venables 2010). The impact on long-distance trade is overproportional because variable transport costs are higher than for short-distance trade while fixed costs are not affected by an increase in trade distance (Mirza and Zitouna 2008, 2009; Kousnetzoff et al. 2008; Gangnes et al. 2011 a, b).

In case of maritime transport, crude oil prices lead to rising ocean bunker fuel prices which then lead to increasing ocean transport costs. Ocean transport costs then affect international trade and particularly long-distance trade volumes as shown in figure 3.1.

Figure 3.1 Ocean Transport Cost Channel

Source: Author's illustration

Krugman (2008) stresses that international trade volumes might decline by up to 17% in case fuel costs would stay at 2008 levels for a long time, thereby shaping the geography of world trade. In 2008, the sustainability of current trade patterns was increasingly called into question by a growing number of trade observers who argued that increasing transport costs may reverse trade globalisation by eliminating comparative advantages[21] of remote low-cost production platforms such as China (UNCTAD 2008).

According to the UNCTAD maritime report (2008: 29), "further research and analysis is needed to thoroughly investigate the actual implications of higher oil prices on transport, comparative advantages, growth and development." The dissertation aims to contribute knowledge to this relatively new field of research.

3.3 Determinants of Ocean Transport Costs

In chapter 6, a number of evaluation criteria are used for the interpretation of the econometric results (see 6.1.2, 6.1.3). Among the evaluation criteria used are determinants of ocean transport costs. Section 3.3 gives an overview of the literature on the determinants chosen for interpretation. These are trade distance (3.3.1), port infrastructure (3.3.2), and economies of scale (3.3.3).

3.3.1 Trade Distance

Trade distance[22] is the most obvious and most studied geographical determinant of (ocean) transport costs[23] (Clark et al. 2002). Due to the fact that transport costs co-vary with trade distance (Hummels 2007a, b), distance has been used as a standard proxy for transport costs in a number of studies (Clark et al. 2002; Geraci and Prewo 1977; Knox and Agnes 1994; Limao and Venables 2001; MacKinnon et al. 2008: 11; Wilsmeier and Martinez-Zarzoso 2010) under the assumption that transport costs increase monotonically with rising distance[24] (Tanaka 2010).

The following sub-sections describe the impact of distance on ocean transport costs (3.3.1.1), the impact of distance on international trade volumes (3.3.1.2), and the link between distance and trade globalisation (3.3.1.3).

3.3.1.1 Trade Distance and Transport Costs

The literature suggests that distance leads to an increase in transportation costs (Kumar and Hoffmann 2002: 43). Mirza and Zitouna (2009) describe this relationship as follows: An increase in trade distance of a given quantity and price increases variable transport costs while leaving fixed transport costs unaffected. Because the relative share of variable costs for trade with distant trading partners is higher than for trade with close partners, transport costs for distant partners become more sensitive, an effect that becomes even stronger in case of an oil price shock.

Clark et al. (2002) estimate that a 100% increase in distance raises maritime transportation costs by 20%.[25] Radelet and Sachs (1998) find that each additional 10% in sea distance leads to an increase of transport costs of 1.3%. Rubin and Tal (2008) report that at record-high oil prices in 2008, every 10% increase in ocean trade distance translated into a 4.5% increase in transportation costs.

Limao and Venables (2001) estimate that the transport costs for shipping a standard container from Baltimore in the United States to selected international destinations increase by $380 (or 8% for a median shipment) for an extra distance of 1,000km. If the journey is broken into an overland and a sea component, an extra 1,000km by sea raise transport costs by $190 (4% of a median shipment) whereas an increase of 1,000km for overland transport raises costs by $1,380 (30% of a median shipment).[26]

Hummels (1999a) estimates the elasticity for distance and transport costs for different commodities. Elasticity figures are between 0.2 and 0.3 with an average elasticity of 0.27. Behar and Venables (2010: 20) report an elasticity of 0.2. Wilsmeier et al. (2006) find a slightly higher elasticity (0.33-0.38) for intra-Latin American ocean trade.

Geraci and Prewo (1977), Hummels (1999a), and Fink et al. (2002) find that transport costs rise at a decreasing rate with distance. Fink et al. (2002) estimate a coefficient on distance between 0.2 and 0.3. Their research also confirms that transport costs increase with distance, but less than proportionally. Abe and Wilson (2009) estimate an elasticity of transport costs per unit weight with respect to port-to-port distance between 0.14 and 0.21.

3.3.1.2 Trade Distance and International Trade Volumes

Distance is negatively related to trade (Behar and Venables 2010; Clark et al. 2002; Krugman 1995). A meta-study by Disdier and Head (2008) examines 103 papers on distance and concludes that the vast majority of the literature confirms the negative relationship. Anderson and van Wincoop (2004) also survey several studies applying the gravity model[27] and find that the bilateral trade distance between two countries typically enters with a coefficient of about $\tau_1 = -0.9$. Bourguignon et al. (2002) report that the typically estimated elasticity of trade flows with respect to distance is between -0.9 and -1.25. They compare trade volumes at different distances relative to their value at 1,000km. With an elasticity of -1.25, trade volumes at 4,000km are down by 82%, and at 8,000km they are down by 93% (Bourguignon et al. 2002).

Frankel and Romer (1999) and Carruthers et al. (2003: 118) find that nations close to world markets enjoy higher levels of trade compared to remote economies. Chasomeris (2007) and Limao and Venables (2001) find that Africa’s poor trade performance is particularly due to a penalty on long trade distances.[28] Additionally, several studies suggest that distance has a strong influence on trade in manufactures (Aviat and Coeurdacier 2004; Portes and Rey 1999; Scholte 2005: 76). Behar and Venables (2010) find that GDP and distance typically account for about 70% of the cross-country variation in trade. Hummels (2007b) finds that countries primarily trade with neighbours. About 25% of international trade takes place between countries sharing a common border. One reason for this may be more developed transportation networks between neighboring countries (Mirza and Zitouna 2009). Moreover, roughly 50% of global trade occurs between countries which are less than 3,000km apart. After controlling for other plausible correlates like country size, tariff barriers or income, Hummels (2007b) finds that the distance of trade explains much of bilateral trade volumes.

The fact that trade volumes are related to the distance of trade indicates the sensitivity of international trade to transportation costs (Hummels and Lugovskyy 2006; Krugman 2008).

3.3.1.3 Trade Distance and Trade Globalisation

As a result of economic globalisation, long-distance trade has grown in recent decades (Hesse and Rodrigue 2004). According to Janelle and Beuthe (1997: 203), by creating distance via the elongation of supply lines, globalisation generates its own demand for transport, thereby placing a toll on energy requirements.[29] Mirza and Zitouna (2009) also emphasise that increasing global trade volumes induce higher global demand for transportation and fuel, which then results in rising prices for the latter. A main driver of increasing trade distance is the trend towards vertical specialisation of production in recent decades in line with trade globalisation. This trend results in longer transport distances due to foreign sourcing (inbound) for manufacturing and for delivery to customers (outbound)[30] (Bardi et al. 2006: 5).

In other words, distance and trade globalisation can be linked by evaluating the relationship between trade globalisation, the location of manufacturing and transport costs. In an ideal typical scenario, Krugman and Venables (1995: 861) describe this relationship and the inherent process as follows: Initially, they suppose that transport costs between regions are high. Therefore, the respective regions are essentially self-sufficient and procduce their own manufactured and agricultural products. An alleged gradual reduction of transport costs then allows for increasing trade between regions and a two-way trade in manufactures arises. However, as long as transport costs stay above a certain level, no vertical specialisation in manufacturing is taking place. Once transport costs fall below a critical point, the world economy begins organising itself into an industrialised core and a deindustrialised periphery. As transportation costs continue to decline, the importance of being close to markets and suppliers becomes less important. Meanwhile, the peripheral regions provide producers the advantage of lower wages. At some point, the continuous transport cost reduction is sufficient so that lower wage rates in the periphery more than offset the disadvantage of remoteness from suppliers and markets. Then, manufacturing gets an incentive to move from the core to the periphery, thereby leading to an increase in the distance of trade.

In case the above description by Krugman and Venables is correct – what would rapidly rising transport costs due to peak oil mean for the location of manufacturing and for the process of trade globalisation? Would the process described above be reversed to a certain extent? And what would be the impact on the export of the semi-manufactured commodity steel from geographically distant countries such as China to the U.S.? The econometric analysis in chapter 6 provides answers to these questions.

3.3.2 Port Infrastructure

Infrastructure is an essential determinant of transport costs (Kumar and Hoffmann 2002: 42; Limao and Venables 2001). Poor infrastructure leads to increasing transport costs (Wilsmeier and Martinez-Zarzoso 2010; Martinez-Zarzoso et al. 2003). On the other hand, while costly to undertake, infrastructure investments reduce transport costs substantially (Behar and Venables 2010: 11).

Limao and Venables (2001) find that infrastructure accounts for up to 40% of the variation in transport costs for coastal economies. A nation with relatively poor infrastructure, for instance ranging at the 75th percentile in an international ranking would reduce its transport costs by 30-50% by upgrading to the 25th percentile. An improvement from the 75th percentile to the median is, according to Limao and Venables, equivalent to a distance reduction of 3,466km by sea or 419km by land and an increase in trade volumes by 28%.

With regard to infrastructure and maritime transport costs, port efficiency is particularly important because ports are the gateways to global trade in ocean transport networks (Rodrigue 2009; Sampson and Yeats 1977). Therefore, given the important role of maritime transport in enabling global trade and growth, well-functioning and efficient ports and shipping services are essential for global trade, international production processes and highly integrated economies (UNCTAD 2009).

Due to the fact that most goods travel by ship[31] (Behar and Venables 2010) and because ports are a crucial interface between land and sea (Stopford 2009: 81), an efficient port infrastructure leads to considerable cost savings (Hummels 2009; Radelet and Sachs 1998). According to Stopford (2009: 81), port improvement plays an important part in reducing sea transport costs. Clark et al. (2002) analyse the impact of port efficiency on maritime transport costs and find that improving the efficiency of a port from the 25th to the 75th percentile lowers shipping costs by 12% while a deterioration from the 75th to the 25th percentile would, on average, be equivalent to being 60% or 5,000 miles farther away from the markets. Clark et al. conclude that port efficiency is an important determinant of maritime transport costs.[32]

3.3.3 Economies of Scale

In the ocean transport industry, economies of scale can be described as the relationship between transport costs and ship size (Chasomeris 2007; Stopford 2009: 222; Wilsmeier and Martinez-Zarzoso 2010). Increasing transport volumes have a strong negative effect on transport costs (Kumar and Hoffmann 2002: 43) due to declining unit transport costs which decrease because of shrinking fixed costs per unit (Rodrigue and Browne 2008: 161).

In the bulk shipping industry, the minimisation of unit shipping costs is of key importance (Stopford 2009: 78). Hence, there is a strong rationale in ocean shipping to achieve economies of scale as they are linked with operation cost reductions, particularly for bulk carriers (Rodrigue and Browne 2008).

During the last 30 years, perhaps the most striking feature of the world shipping fleet has been the rapid growth of ship size, particularly in the fleet's bulk sector (Stopford 2009: 153). The upward trend for bulk carriers is, amongst other things, a consequence of the fact that the ocean transport industry has more or less a monopoly on the transport of large volumes of cargo between continents (Christiansen et al. 2007: 191).

The average size of bulk carriers increased from less than 20,000dwt in 1960 (Lundgren 1996) to 56,000dwt in 2006 (Stopford 2009: 76). The average size of newly delivered bulk carriers in 2009 was 71,000dwt indicating a continuing trend towards economies of scale[33] (UNCTAD 2009: 92). Due to this trend, the unit transport costs per ton[34] (Sampson and Yeats 1977; Stopford 2009: 354) and, even more important, the average cost per cargo ton-mile have been reduced significantly over time (Christiansen et al. 2007: 202).

The following example illustrates the effect economies of scale have on costs per cargo ton. In 2005, annual costs for a 30,000dwt bulk carrier were about $191 per cargo ton, compared with $143 per cargo ton for a 47,000dwt bulk carrier, $120 per cargo ton for a 68,000dwt bulk carrier, and $74 per cargo ton for a 170,000dwt Capesize bulk carrier. Over time, the overall growth of ship size reduced unit shipping costs by 75%. Therefore, economies of scale played a major part in keeping maritime transportation costs low (Stopford 2009: 40, 75, 224). In relative figures, switching from a Handy bulk carrier to a Handymax carrier saves about 22% per cargo ton, whilst moving to a Panamax carrier saves 20%, and upsizing to a Capesize carrier saves another 36% per ton.

These figures indicate that economies of scale are a main reason for decreasing ocean transport costs (Lundgren 1996). Despite the trend to economies of scale, however, Pedersen (2001) stresses that the importance of ocean transport costs has not decreased over time[35].

4 Data Series

In chapter 4, the rationale behind the selection of the research variables used for analysis is explained and the data series used are described (4.1). Moreover, the rationale behind the selection of the sample period and data frequency is also explained (4.2).

4.1 Variable Selection and Data Series Description

Section 4.1 desribes the reasons for the selection of the research variables used for analysis and the data series used for the research variables 'U.S. Steel Imports' (4.1.1), 'U.S. Steel Import Value' (4.1.2), 'Real Oil Price' (4.1.3), 'Exchange Rates' (4.1.4) and 'U.S. Real GDP' (4.1.5).[36]

4.1.1 U.S. Steel Imports

Variable Selection

Selected Commodity/Industry

The international steel industry has been chosen for the analysis for the following reasons: The industry employs two million people and a further two million contractors. Moreover, four million people work in supporting industries. The industry is a key product supplier for the automobile, construction, transport, power, and machine goods industries amongst others and therefore is a cornerstone of the global economy (World Steel Association 2012). Furthermore, steel, which is usually worth between $600-1,000 per ton (Stopford 2009: 54), is a key commodity for the development of industrialised and industrialising nations (UNCTAD 2008).

Steel products are standardised internationally to a large extent, thereby making possible comparability on an international stage. Finally, the value-to-weight and the value-to-freight-cost ratios (high share of transport costs in relation to final selling prices) for steel are low compared to other commodities. Therefore, economic theory suggests that long-distace steel trade should be relatively vulnerable in view of rapidly rising transport costs due to spiking crude oil prices.

Selected Importing Country

The United States have been chosen as the steel importing country for the study, because the U.S. economy is the biggest national economy with significant steel imports and a distinct domestic steel industry, the third-largest worldwide.[37] Moreover, the U.S. Census Bureau publishes accurate statistics on international trade due to consistent data collection standards/procedures and regular data quality assessments (U.S. Census 2002).

Selected Exporting Countries

During the sample period (see 4.2), 121 of the 240 U.S. trading partners exported steel to the United States (U.S. Census 2012a). Of those 121 countries, 50 have been excluded from the analysis because of their low export frequency[38], and 7 countries[39] have been dropped from the analysis due to data availability problems and/or the introduction of a new currency during the sample period. The remaining 64 countries[40] used for the analysis are listed in table 4.1.

Table 4.1 Selected Exporting Countries

European Union		**Other Europe**	**North America**	**South America**	**Middle East**	**Asia**
Austria	Latvia	Norway	Canada	Argentina	Israel	China
Belgium	Lithuania	Switzerland	Costa Rica	Brazil	Saudi Arabia	Hong Kong
Bulgaria	Luxembourg	**C.I.S.**	Dominican Republic	Chile	Turkey	India
Czech Republic	Netherlands	Kazakhstan	El Salvador	Colombia	United Arab Emirates	Indonesia
Denmark	Poland	Russia	Guatemala	Ecuador	**Oceania**	Japan
Estonia	Portugal	Ukraine	Honduras	Peru	Australia	Malaysia
Finland	Romania		Mexico	Uruguay	New Zealand	Philippines
France	Slovakia		Panama	**Africa**		Singapore
Germany	Spain		Trinidad and Tobago	Algeria		South Korea
Hungary	Sweden			Egypt		Taiwan
Ireland	United Kingdom			South Africa		Thailand
Italy						

In addition to the total export datasets of the 64 countries analysed, the 'American Iron and Steel Product Groups' datasets of the 18 most important steel exporting countries are used for a more in-depth analysis. Among the 18 countries selected[41], there are 14 of the top 15 exporters of semi-finished and finished steel products in 2008.[42] From a geographical point of view, the analysis by steel product category includes countries from all eight world regions[43]:

- Europe: Belgium, France, Germany, Italy, the Netherlands, Spain
- C.I.S.: Russia, Ukraine
- North America: Canada, Mexico
- South America: Brazil
- Middle East: Turkey
- Africa: South Africa
- Asia: China, Japan, South Korea, Taiwan
- Oceania: Australia

Based on the above-mentioned facts, U.S. steel imports have been selected as the dependend variable for this study. The variation of this variable during the sample period (see 4.2) shall be explained by the explanatory variables introduced below.

Dataset Description

The dataset that includes data for U.S. steel imports and U.S. steel import values has been collected from the U.S. Census Bureau. The U.S. Bureau of the Census is responsible for collecting, compiling, and publishing trade statistics for the United States (U.S. Census 2010a). In this context, the Census Bureau's Foreign Trade Division, the official U.S. Government source for statistics on foreign trade (U.S. Census 2003), publishes the 'U.S. Merchandise Trade Statistics', the official source of information about U.S. imports and exports (U.S. Census 2002; 2010b) which include the 'U.S. Imports for Consumption of Steel Products (FT900A)' section (U.S. Census 2011a). The trade data published in this report are compiled from documents collected by the U.S. Customs and Border Protection[44] (U.S. Census 2009a).

The data are initially collected and compiled by the U.S. Census Bureau based on the terms of commodity classifications of the 'Harmonized System (HS)'[45], which is interrelated with the 'Standard International Trade Classification (SITC)'.[46] The import statistics are based on the 'Harmonized Tariff Schedule of the United States Annotated for Statistical Reporting Purposes (HTSUSA)' which is the import version of the HS (U.S. Census 2009a; 2010b).

The FT900A section includes monthly aggregates for U.S. steel imports in quantity metric tons (qmt) and the U.S. steel import customs value[47] in nominal U.S. dollars[48] (Higbee 2011, 2012; U.S. Census 2004).

These datasets are available online from November 1998 until the present.[49] They include data on total U.S. steel import volumes per country of origin and data for 39 'American Iron and Steel Product Groups' for each country of origin. The steel product groups are listed in table 4.2.

Table 4.2 American Iron and Steel Product Categories

Categories					
1A	Ingots And Steel For Castings	15	Bars – Reinforcing	23	Wire Drawn
1B	Blooms, Billets and Slabs	16	Bars – Cold Finished	28	Black Plate
3	Wire Rods	17	Tool Steel	29	Tin Plate
4	Structural Shapes Heavy	18	Standard Pipe	29A	Tin Free Steel
5	Steel Piling	19	Oil Country Goods	31	Sheets Hot Rolled
6A	Plate Cut Lengths	20/20A-C*	Line Pipe	32	Sheets Cold Rolled
6B	Plates In Coils	21A	Mechanical Tubing	33A	Sheets & Strips Galv Hot Dipped
7	Rails Standard	21B	Pressure Tubing	33B	Sheets & Strips Galv Electrolyt
8	Rails All Other	21CD	Stainless Pipe & Tubing	34	Sheets & Strips All Other Metal
9	Railroad Accessories	21E	Pipe & Tubing Nonclassified	35	Sheets & Strips – Electrical
14	Bars – Hot Rolled	22A	Structural Pipe & Tube	36	Strip –Hot Rolled
14A	Bars – Light Shaped	22B	Pipe For Piling	37	Strip –Cold Rolled

*20 Line Pipe until December 2000[50]

20A Line Pipe > 16 Inches In Diameter; from January 2001

20B Line Pipe ≤ 16 Inches In Diameter; from January 2001

20C Line Pipe – Not Specified; from January 2001

Source: U.S. Census 2007

4.1.2 U.S. Steel Import Value

Variable Selection

According to the U.S. Census Bureau (2012b), the U.S. steel customs value is the price actually paid or payable for steel when sold for exportation to the United States, excluding U.S. import duties, freight, insurance, and other charges incurred in bringing the merchandise to the United States.

The customs value for steel includes upstream trade costs for commodities used for steel production (e.g. iron ore and coking coal), labour costs and other production costs on which comparative advantages in the very fluid and competitive steel market are based. For this reason, the U.S. steel import value has been selected as an explanatory variable that can explain the variance of the U.S. steel import variable. On the other hand, the U.S. steel import value does not include maritime fuel costs. In this study, the real oil price is used as a proxy for maritime fuel costs (see 4.1.3).

Dataset Description

The dataset that includes data for U.S. steel imports and U.S. steel import values during the sample period has been collected from the U.S. Census Bureau and is described in section 4.1.1.

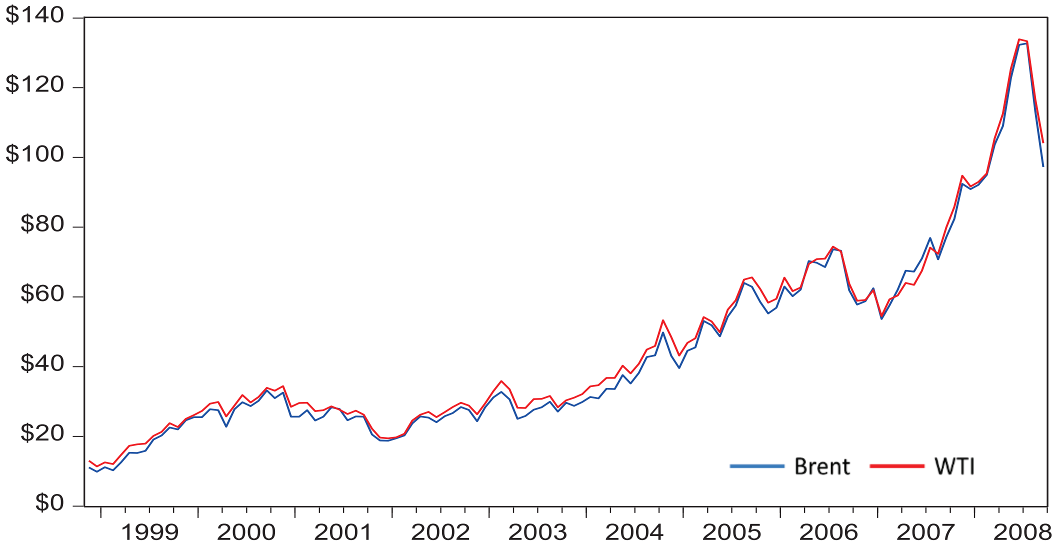
4.1.3 Real Oil Price

Variable Selection

The dissertation analyses the impact of high crude oil prices on U.S. steel imports. Therefore, the oil price variable, which is used as a proxy for bunker fuel costs, is the most important explanatory variable for this study. Beverelli (2010) finds that for the time period between June 1990 and November 2008, the coefficient of correlation between bunker fuel prices and the Brent oil price series is 0.98. At the same time, the Brent oil price series and the West Texas Intermediate (WTI) oil price series, which is used in this study, are almost identical during the sample period (see figure 4.1).

According to Beverelli (2010: 8), "the correlation between WTI and Brent is equal to 0.994; therefore the use of one or the other indicator should not be a concern." Hence, it is reasonable to use the WTI series as a proxy for bunker fuel costs.

Figure 4.1 Brent vs. WTI, 11/1998-09/2008



Source: Author's illustration (EViews®), data: EIA 2011e; 2011g;
deflator: consumer price index (CPI)

<u>Dataset Description</u>

The oil price data series used in this study has been obtained from the U.S. Energy Information Administration (EIA) and contains monthly oil price data for the WTI oil grade. The EIA is the statistical and analytical agency of the U.S. Department of Energy (DOE). The premier source of energy information in the U.S. conducts a comprehensive data collection program covering the full spectrum of energy sources, end uses, and energy flows (EIA n.d.a).

The data series contains monthly WTI oil price data from January 1986 – to the present[51] in U.S. dollars.[52] The EIA calculates the monthly oil price data from daily data by taking an unweighted average of the daily closing spot prices for a given product during the specified time period. (EIA 2011c, n.d.b)

WTI is "a crude stream produced in Texas and southern Oklahoma which serves as a reference or 'marker' for pricing a number of other crude streams and which is traded in the domestic spot market at Cushing, Oklahoma." (EIA n.d.e.) There are actually three different blends serving as benchmarks for crude oil pricing, WTI, Brent, and Dubai (Korhonen and Ledyaeva 2010). World oil prices are established in relation to these markers (EIA n.d.c; OECD 2007). Therefore, it is common practice to select one of these reference blends for research. WTI has been chosen because it is most important for the U.S. economy. WTI is produced domestically and traded in the spot market in Oklahoma and on the New York Mercantile Exchange (NYMEX) (EIA n.d.d). WTI oil prices are frequently used in other studies (e.g. Chen and Hsu 2012; Faria et al. 2008; Korhonen and Ledyaeva 2010). As already described above, the correlation between WTI and maritime bunker fuel is close to 1 for the sample period which makes WTI a good proxy for ocean bunker fuel.

4.1.4 Exchange Rates

Variable Selection

Exchange rates influence international trade due to appreciation (a currency becomes more valuable) and depreciation (a currency loses value) and related exchange rate risks (Gerber 2008: 211ff). Due to the fact that appreciation/depreciation trends are influencing international (steel) trade volumes, the exchange rate variable has been included in the econometric analysis.

Dataset Description

The exchange rate datasets used for the econometric analysis have been collected from the Federal Reserve Bank (FED), from the Organisation for Economic Cooperation and Development (OECD), and from the OANDA currency conversion system. Each of the datasets collected contains the exchange rate between the U.S. dollar and the currency of one of the 64 steel exporting countries analysed. The specifics of the datasets are described below.

The FED's 'Foreign Exchange Rates – G5' release contains monthly averages of bilateral exchange rates (FRB 2011, 2012).[53] The averages "are based on daily noon buying rates for cable transfers in New York City certified for customs purposes by the Federal Reserve Bank of New York." (FRB 2012)

The 'Financial Indicators' dataset published by the OECD is a subset of the 'Monthly Monetary Statistics' dataset which is part of the 'Main Economic Indicators' (MEI) database and contains monthly bilateral exchange rates between the U.S. and the other 33 OECD member countries as well as exchange rates between the U.S. and the non-member countries Brazil, China, India, Indonesia, Russia, and South Africa[54] (OECD n.d.).

The exchange rates provided by the OANDA currency conversion system[55] are averages for the global foreign exchange market. The data are gathered from the OANDA fxTrade currency platform and from other market data vendors and financial institutions from which interbank market rates are taken. Averages are taken from the data collected over a 24 hour period and are then rounded to up to five significant digits. The data are then further aggregated to monthly and quarterly averages (OANDA n.d.c). In the conversion system, exchange rates are available for all active currencies for any date since 1990[56] (OANDA n.d.b).

4.1.5 U.S. Real GDP

Variable Selection

The U.S. GDP, or "the market value of goods and services produced by labor and property in the United States" (U.S. Census 2012b), influences U.S. import volumes. In brief, economic theory suggests that significant growth in U.S. GDP eventually leads to rising incomes and increasing consumption which then translates into increasing import levels. Vice versa, negative U.S. GDP growth leads to stagnating/falling incomes and decreasing consumption which then translates into decreasing import levels (Gerber 2008: 220).

Steel import volumes to the U.S. can be impacted significantly by a growth/decline of GDP figures because the steel industry is a key product supplier for the automobile, construction, transport, power, and machine goods industries amongst others (World Steel Association 2012). Therefore, the U.S. real GDP variable has been included in the econometric analysis.

Dataset Description

Data for the U.S. GDP are only published on a quarterly basis, e.g. by the Bureau of Economic Analysis (BEA). The frequency chosen for this study, however, is monthly. Therefore, monthly U.S. Real GDP data were purchased from E-forecasting[57], a provider of business-related indicators and datasets.

The purchased dataset contains monthly U.S. real GDP data, which are expressed at seasonally adjusted, chained 2002 dollars, from 1959 until the present.[58] The monthly figures are calculated as follows: In order to develop the series, a systematic diffusion process relates monthly information of three monthly indicators to quarterly GDP. The three monthly indicators are

1. a national monthly output index based on monthly estimates of labour productivity which are combined with monthly labour data.
2. production indices covering the goods producing sectors of the U.S. economy which are constructed from output measured in physical units and inputs used in the production process.
3. monthly measures of incomes derived from production and adjusted for price changes.

These three national composite components are aggregated into a monthly GDP series after they have been labour-adjusted for productivity, production of goods, and incomes.

After estimating the monthly GDP data by applying real-time monthly diffusion metrics, the series is statistically standardised to the quarterly GDP published by the U.S. Department of Commerce (DOC) (E-forecasting 2012; Simos and Simos 2005).

4.2 Sample Period/Sample Size and Data Frequency

The sample period selected (11/1998 – 09/2008) includes 119 observations and covers the time period between the end of the Asian crisis in 1997/98 and the beginning of the global financial crisis in September 2008 (Lehman bankruptcy).

The start and end dates of the sample period were selected for the following reasons: Between the mid-1980s and most of the 1990s, oil prices were comparatively low. Including oil prices from that period does not make sense for the analysis of the impact of high oil prices on steel exports to the United States. After the beginning of the financial crisis in September 2008, oil prices plunged rapidly from $133 to $30. Although, oil prices have again risen above the $100 mark since then, at the time of this writing the world economy remains in a state of crisis where normal evaluation standards cannot be imposed.

The data frequency chosen is monthly aggregates. Daily and weekly U.S. steel import data are not available and the number of observations would have been insufficient if annual aggregates would have been used. Therefore, monthly aggregates are best suited for the analysis.

5 Methodology

Chapter 5 first describes the rationale behind the selection of the methodological approach for the study (5.1). The subsequent sections then describe the specification and estimation (5.2) and the analysis of VAR/VEC models (5.3). Here, only the main equations used for calculation are emphasised and brief descriptions are given due to space limitations and because the methodological approach used has become very standard in recent years. References for further reading have been placed throughout the text where necessary.

5.1 Choice of Econometric Approach

In econometrics, model selection is a serious matter that should not be taken lightly because the choice of an econometric approach includes implicit decisions regarding the outcome of a research project. Therefore, the model selection process or the decision making process leading the the choice of the appropriate model for the study is explained in detail.

In that context, section 5.1.1 first describes the decision making process regarding the choice between vector autoregression models and simultaneous equation models. Section 5.1.2 then explains the rationale behind the choice of a restricted VAR or error correction model and why an unrestricted VAR model has not been selected.

5.1.1 Vector Autoregression Models vs. Simultaneous Equation Systems

The econometric approaches typically applied for the analysis of multivariate time series are simultaneous equation (SEQ) systems and vector autoregression (VAR) models. Both approaches employ some kind of linear regression or maximum-likelihood methods for estimation. There are, however, differences when it comes to the models' implicit assumptions and building blocks forming the basis for inference and interpretation.

SEQ model building rests upon (economic) theory which is then rendered into a set of equations. This modus operandi necessitates choices about the endogeneity and exogeneity of variables. The decision making process results in a single structural system of equations which expresses the relationships among the incorporated variables.

The VAR approach does not intend to estimate the accurate structure of the underlying relationships among the time series analysed but instead focuses on the underlying correlation and the dynamic structure of the time series used. Here, the main focus is on the data and their dynamics and the model's central tenet is that restrictions imposed on data and parameters used should be viewed skeptically. Contrary to standard SEQ systems, the VAR approach is based on the creation of a complete dynamic specification of the time series in a system of equations. This procedure originates from the Wold decomposition theorem (Hamilton 1994: 108f.; Wold 1954).

The invention of the VAR methodology can be credited to Sims (1972, 1980) who rejected the SEQ approach for the following reasons:

- According to Sims, identification restrictions on parameters used in the SEQ approach are often not theory-based and may therefore cause incorrect conclusions regarding the model's structure and estimates.
- Sims stresses that SEQ models are regularly built on tenuous assumptions with regard to the endogeneity and exogeneity of the variables used. Due to the fact that the true lag lengths of the variables involved are not known a priori, identification is then based on possibly specious assumptions in terms of exogeneity. The formal identification of dynamic simultaneous equation models, however, requires knowledge about the exact true lag length for each variable or the identification assumptions may not hold (Hatanaka 1975).

The method proposed by Sims aims to ensure that the approach to modeling multiple time series makes possible the comprehensive characterisation of the dynamics of time series. In order to account for the dynamics of the variables involved, a multivariate autoregressive model can be used that regresses each variable on its past values and on the past values of the other variables included in the system. Usually, the identical lag length is used for each variable in the equation. The selection of adequate variables is based on (economic) theory while the specification of the model's structure proceeds by testing for the appropriate lag length using sample data.

Rather than beginning with a set of structural, dynamic, or a-priory causal relationships among the variables, VAR models start with the assumption that the reduced form dynamics are of main interest. That is, instead of imposing possibly structural or dynamic restrictions on the relationships among the time series, a VAR model has an own equation for each variable used in the analysis. After every variable has been regressed on its past values and the past values of the other variables in the system and after testing for autocorrelation, the resulting residuals become exogenous shocks or innovations. It is then possible to analyse the responses of each equation to exogenous shocks to estimate to what extent exogenous shocks in each variable affect the observed system. Subsequent to checking for these dynamics, inferences about the Granger causal relationships between the variables can be made and the endogenous structure and dynamics of the series can be determined.

As already indicated above, the key distinction between the VAR and the SEQ approach is the treatment of identification assumptions. The SEQ approach takes assumptions as fixed, invariant, and specified by theory. In the VAR approach, however, the correctness of zero-order restrictions (for example excluding variables from specific equations or omitting lagged values of variables from specific equations) is taken into doubt. The VAR model approach aims to eliminate biases from flawed restrictions by trading off these biases for a certain extent of inefficiency. On the other hand, biases in the SEQ model are often due to omitted lagged values which in fact should have been included. Sims argues that the lags of some variables are often wrongly excluded in the SEQ model identification process. Such incorrect restrictions result in the omission of relevant lagged variables, thereby producing omitted variable bias. The solution forwarded in the VAR approach is to include all possible lags, in case of doubt more than necessary, thus trying to prevent biases at the cost of efficiency.

In VAR models, the decisive identification assumption is how the contemporaneous effects of the respective variables are related to each other. VAR models are specified in terms of the lagged values of the variables in the system on each other. Therefore, identification concerns the specification of the residual or contemporaneous covariance matrix of the residuals alone, thereby allowing for the separation of the model's interpretation from the identification process. Accordingly, it is possible to explicitly look how decisions regarding identification are related to the path of the variables' dynamics.

Pagan (1987) stresses that VAR models work best when they are based on a simple and unbiased specification accounting for the uncertainty about the dynamics and the model. Therefore, contrary to the 'specify-estimate-test-respecify' logic of SEQ models, in VAR models few hypothesis tests are used to justify their specification.

Both approaches introduced above have specific advantages/disadvantages (e.g. risk of misspecification vs. risk of inefficiency). However, the main reason for adopting the VAR approach for this study is due to the analysis tools available which best serve the purpose to analyse the impact of oil price shocks on long-distance trade. According to Breitung et al. (2004: 161), the VAR approach is predestined to analyse the impact of economic shocks such as oil price shocks, exchange rate shocks or monetary shocks. When the primary target is to examine the dynamics among specific variables and the impact of (oil price) shocks on other variables as is the case here, the VAR approach is typically superior to the SEQ approach because it is less likely to be overly precise via ad hoc model pretesting. Using a VAR model makes possible the investigation of the 'causal effects' of endogenous variables on each other (Granger causality testing), the dynamic impact of changes in one variable on the other variables in the model (impulse response analysis), and the amount of variance in each variable which can be attributed to each variable itself and the other variables in the equation system (variance decomposition analysis) (Brandt and Williams 2007: 4-15; Canova 1999: 78; Kirchgässner and Wolters 2007: 149; Stevans and Sessions 2010).

For these reasons, the VAR approach has also been adopted in a number of other studies researching the impact of oil price shocks on other economic variables such as GDP (see for example Hamilton 1996, 2003; Kilian and Vigfusson 2011; Lee et al. 1995; Mork 1989).

5.1.2 Vector Autoregression Models vs. Vector Error Correction Models

In recent decades, the influence of Sims' methodologic invention in the profession has been pervasive (Canova 1999: 73) and nowadays VARs play a crucial role in modern approaches to analyse economic time series (Kirchgässner and Wolters 2007: 126). However, the approach has been and continues to be subject to continuous development. One reason for enhancements of the methodology has been the "cointegration revolution" (Kirchgässner and Wolters 2007: V; Lütkepohl 2005: VII) following the work of Engle and Granger (1987) that started in the late 1980s/early 1990s and had an influence on applied work in a substantial manner (Kirchgässner and Wolters 2007: V), for example in form of the invention of error correction models (Lütkepohl 2004: 158).

In economics, trending time series are quite common (Lütkepohl 2005: 2). Therefore, the presence of unit roots in time series used is an important issue in VAR modelling because the requirements for estimation and the distributions of the parameters demand covariance stationarity (Brandt and Williams 2007: 47; Hamilton 1994).To fulfil the requirement of covariance stationarity, the roots of the multivariate lag polynominal for the VAR model need to be outside the unit circle. When a VAR contains non-stationary time series, this can lead to spurious regressions (Stevans and Sessions 2010).

In order to avoid spurious regressions, non-stationary time series used to be differenced. However, if possible data transformations that difference the data to remove trends should be avoided. By differencing the data the long-term components of the series are removed, thereby eliminating a large portion of the variable's trends and paths which shall be explained and distorting the relationship between the original variables (Brandt and Williams 2007: 47; Hackl 2005: 317; Lütkepohl 2005: 244).

When trending time series have a common stochastic trend, they are cointegrated (Lütkepohl 2004: 87). Then, the differencing of the time series can be avoided. Therefore, VARs specified in first differences should only be set up if non-stationary variables which are not cointegrated shall be used (Lütkepohl 2005: 244; Stevans and Sessions 2010). According to Lütkepohl (2004: 87), "if cointegrating relations are present in a system of variables, the VAR form is not the most convenient model setup. In that case, it is useful to consider speficic parameterizations that support the analysis of the cointegration structure. The resulting models are known as vector error correction models (VECM)."

A VECM is a restricted VAR model designed for use with cointegrated non-stationary time series. The specification of VECMs includes a cointegrating relation term also known as the error correction term (EViews 2010). Before deciding between an unrestricted VAR and a restricted VAR (or VECM), Engle and Granger suggest that one should first test for the presence of unit roots in each variable used and then test for cointegration relationships among the variables if necessary. In case cointegration exists between I(1) variables, an unrestricted VAR should be set up and transformed into a VECM, thereby producing a stationary system with non-stationary individual time series. After that, one should proceed with standard estimation and inference (Brandt and Williams 2007: 47; Canova 1999: 83; Freeman et al. 1998).

The samples used in this study all contain at least two trending time series. “If some of the variables are I(1), a VECM is the suitable modelling framework” (Lütkepohl 2004: 112) when a cointegration relationship exists among the I(1) variables. Therfore, a VECM is used for estimation in case cointegration relationships between the trending variables can be identified (Götze 2008; Sims et al. 1990) because ignoring cointegration relationships among I(1) variables may lead to substantial biases in the calculated impulse response and variance decomposition estimates (Stevans and Sessions 2010).

5.1.3 Summary

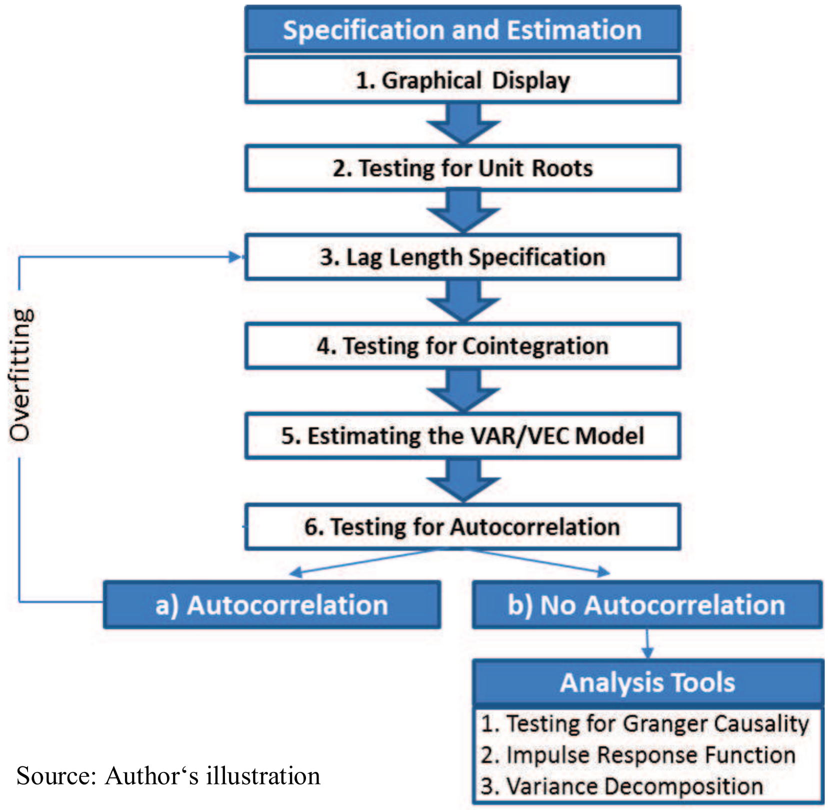
The selection of an econometric model is a serious matter that should not be taken lightly. Therefore, section 5.1 gives a detailed account of the decision making process involved in the choice of the appropriate model and explains why the VAR approach has been chosen instead of the SEQ approach and why a restricted VAR or VECM is used for estimation instead of an unrestricted VAR model.

In that context, it needs to be mentioned that the both restricted and unrestricted VAR models are subject to criticism in the literature as indicated above. However, a more detailed discussion on the advantages and disadvantages of VAR modelling would certainly go beyond the scope of this dissertation. For more detailed VAR-criticism, the reader is therefore referred to Brandt and Williams (2007: 56ff.), Canova (1999: 103ff.), Darnell (1994: 423), and Patterson (2000: 645ff.).

5.2 VAR/VEC Specification and Estimation

Figure 5.1 shows the process of specification, estimation and analysis of a VAR/VEC model as suggested by different econometric textbooks (e.g. Brandt and Williams 2007; Darnell 1994: 422; Lütkepohl 2004: 110; 2005: 325, 345).

Figure 5.1 Process of Specification, Estimation and Analysis of the VAR/VEC Model



Source: Author‘s illustration

Section 5.2 first describes the specification and estimation process of VAR/VEC models and the specification tests applied. Section 5.3 then describes the analytical process and the analysis tools used.

The specification/estimation process is structured as follows: After testing for the presence of unit roots in the time series used (5.2.1), the appropriate lag length for the model is specified (5.2.2) and the trending time series in each sample are tested for common cointegrating relationships (5.2.3). Depending on the outcome of these specification procedures, a restricted (VEC) or unrestricted VAR model is estimated (5.2.4). After the adequate model has been set up, it is essential to test for autocorrelation to make sure that the residuals are uncorrelated over lagged time periods (5.2.5).

5.2.1 Testing for Unit Roots

In order to test for unit roots in the times series used for analysis, the data series are displayed graphically (5.2.1.1) and unit root tests are conducted (5.2.1.2).

5.2.1.1 Graphical Display

The data series used are displayed graphically (see appendix, section A2) to get a first impression of the respective time series and to look for possible local trends (short time stretches in which a time series appears to move in a specific direction) and unit roots.

5.2.1.2 Testing for Unit Roots

The samples analysed in this study all contain variables with unit roots. This had to be expected because many macroeconomic time series such as real GDP or exchange rates typically have unit roots (Franz 2005). A unit root or stochastic trend variable is characterised as integrated of order *d* (I(*d*)) because it needs to be differenced *d* times to make it stationary.

Therefore, prior to bivariate or multivariate time series modelling, the data series used need to be pre-tested for the presence of unit roots in order to prevent spurious regressions due to the use of nonstationary time series as documented by Granger and Newbold (1974).

The reason for this is that the causality between dependent and explanatory variables can be overstated when the variables have a similar underlying trend. In that case when a strong relationship between two or more variables is not caused by a real underlying causal relationship, the variables are said to be spuriously correlated, thereby resulting in spurious regressions in which the t-scores are likely to be overstated. This in turn may lead to incorrect model specification. As indicated above, the danger of obtaining apparently significant regression results from unrelated data can be prevented by testing the data series used for nonstationarity or rather unit roots[59] (Hill et al. 2008: 333f.; Studenmund 2010: 417ff.).

There are multiple unit root tests which can be used to test for nonstationarity of which the Dickey Fuller Test (DF) is used most frequently (Dickey and Fuller 1979). The Augmented Dickey Fuller (ADF) test, which has been developed by Said and Dickey (1984) is a significant extension of the basic DF test allowing for the possibility that the error term *t* is autocorrelated. Such serial correlation may occur in case a model does not have a sufficient number of lag terms to capture the full dynamic of a process. In practice, it is best to use the ADF to ensure that the errors are uncorrelated. The extended ADF test equation for a model with intercept[60] is

[5.1] $$\Delta y_t = \alpha + \gamma y_{t-1} + \sum_{s=1}^{m} a_s \Delta y_{t-s} + \nu_t$$

where $\Delta y_{t-1} = (y_{t-1} - y_{t-2})$, $\Delta y_{t-2} = (y_{t-2} - y_{t-3})$, … .

As many lags as needed are added to make sure that the residuals are not autocorrelated (Hill et al. 2008: 335). The null hypothesis and the alternative hypothesis are set up as follows: H_0: $\gamma = 0$ and H_1: $\gamma < 0$.

H_0 is tested by estimating the test equation by least squares and by examining the so called τ (tau-) statistic with its specifically created critical values for $\gamma = 0$ which are valid for one-tail tests. The critical values can be found in Davidson and MacKinnon (1993: 708) and Hill et al. (2008: 337). While $\tau \leq \tau c$ suggests stationarity, $\tau > \tau c$ suggests nonstationarity.

In case of nonstationarity, the datasets are again tested for stationarity after taking first differences. In the ADF testing process, different information criteria can be applied. The Schwarz Information Criterion (SIC) has been selected for unit root testing. However, the Akaike Information Criterion (AIC) and the Hannan Quinn Criterion (HQC) are also used for control purposes and to get additional information regarding the likelihood of unit roots in the time series. The ADF test results can be found in the appendix, section A3.

For a more detailed discussion of the ADF test, the reader is referred to Hill et al. (2008: 335ff.) or Studenmund (2010: 421ff.).

5.2.2 Lag Length Specification

Because subsequent testing procedures (e.g. tests for cointegration and serial correlation) and the VAR coefficients or VAR estimation results are influenced by lag length, the optimal lag length *p* is determined next (Patterson 2000: 623).

When determining the optimal lag length, usually enough lags are included to capture the full cycle of the data (e.g. 12 lags for monthly data). In case some seasonality is expected to be carried over from year-to-year and across the months longer lag lengths (e.g. 13-15 for monthly data; 6-10 lags for quarterly data) may be used in order to capture the cyclical components in the year and any residual seasonal components in the majority of cases. This is necessary because even in de-seasonalised data, it is quite possible to have residual seasonal patterns in the data which must be modelled.

If the maximal lag length used is changed in the lag length determination process this may also yield different results. Therefore, it is quite common that a number of models with different lag lengths must be estimated to determine the optimal lag length (Cottrell and Lucchetti 2012: 206; Lütkepohl 2004: 153). As a consequence, different maximal lag lengths (10-15) are tested to make sure that the lag length suggested is not influenced by the maximal lag length chosen.

Another rule for lag length selection is that no more than one quarter of the degrees of freedom available for each equation should be used.[61] There are two main reasons for this limitation:

1. If too many degrees of freedom are used, this leads to relatively inefficient estimates.
2. If too many lags are included, the OLS estimates cannot be computed, because too many lags may lead to a singular and noninvertible (X'X) matrix.

The most common approach used to test for lag length in a VAR model is the use of information criteria such as the Schwarz Information Criterion (SIC), the Akaike Information Criterion (AIC) or the Hannan-Quinn Criterion (HQC) which are based on the likelihood function for a model and determine the trade-off between model fit and parsimony. In case of two models which fit the data equally well, the more parsimonious model would be penalised less and would therefore be preferred. Thereby, the information criteria introduced above penalise additional parameters differently:

[5.2] $$AIC(p) = T\log\left|\hat{\Sigma}\right| + 2(m^2 p + m),$$

[5.3] $$BIC(p) = T\log\left|\hat{\Sigma}\right| + \log(T)(m^2 p + m),$$

[5.4] $$HQC(p) = T\log\left|\hat{\Sigma}\right| + 2(\log(\log(T)))(m^2 p + m),$$

where

T = sample size under a model with $p_{\max}$ lags

$\log\left|\hat{\Sigma}\right|$ = log determinant of the error covariance for a model with p lags

m = number of endogenous variables in the VAR model.

The final term in each of equations [5.2] – [5.4] is a penalty for the model's number of parameters. Thereby, the higher the number of parameters, the greater the penalty to the respective fit of the criterion statistics.

The lag length p which eventually yields the smallest value – dependent on the number of lags $p < p_{\max}$ included in the model – is considered the optimal lag length for the model. Of course, the information criteria may select different optimal lag lengths and lag length selection can also be influenced by the choice of $p_{\max}$. Therefore, different values for $p_{\max}$ should be tested[88] (Brandt and Williams 2007: 24ff.; Maddala 2001: 527). Thereby, different information criteria (SIC, AIC, HQC) are used for decision making (The information criteria may recommend different optimal lag lengths (Schulze 2004).) with a first preference for the SIC[62] and a second preference for the HQC as recommended by Lütkepohl (2005: 326) and

Kirchgässner and Wolters (2007: 133). Using multiple information criteria for decision making is also common practice in other studies (e.g. Constantin and Cernat-Gruici 2010, Jiménez-Rodríguez 2008).

The reason for preferring the SIC and HQC over the AIC is that the SIC and HQC are consistent for stationary and integrated processes while the AIC, although employed regularly (e.g. see Frank and Garcia 2010), is not consistent and asymptotically overestimates the the true order of the (finite) maximal lag length. Moreover, the SIC is preferred over the HQC because it performs very well when it comes to lag length specification (Patterson 2000: 649). By tendency, the following proposition holds for the lag lengths suggested by the different information criteria:

$$\hat{p}\,(SIC) \leq \hat{p}\,(HQC) \leq \hat{p}\,(AIC) \quad \textit{for} \;\; T \geq 16$$

It is noteworthy that the information criteria can be used for I(1) processes with cointegrated variables (Kirchgässner and Wolters 2007: 133; Lütkepohl 2005: 327).

5.2.3 Testing for Cointegration

The concept of cointegration has been developed by Granger (1981) and Engle and Granger (1987) and can be defined as follows: "Cointegration consists of matching the degree of nonstationarity of the variables in an equation in a way that makes the error term (and residuals) of the equation stationary and rids the equation of any spurious results. Even though individual variables might be nonstationary, it is possible for linear combinations of nonstationary variables to be stationary, or *cointegrated*." (Studenmund 2010: 424)

The Johansen test was developed by Johansen (1991; 1995) to identify the number of cointegrating vectors in a VAR model and is used by default for multivariate time series models. In a VAR model of order p

[5.5] $$y_t = A_1\, y_{t-1} + \cdots + A_p\, y_{t-p} + B\, x_t + \varepsilon_t$$

y_t is a k-vector of I(1) variables, x_t is a d-vector of deterministic variables, and ε_t is a vector of innovations. This unrestricted VAR can be rewritten as a VECM

[5.6] $$\Delta\, y_t = \Pi\, y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta\, y_{t-i} + B\, x_t + \varepsilon_t$$

where

[5.7] $$\Pi = \sum_{i=1}^{p} A_i - \mathrm{I}, \qquad \Gamma_i = -\sum_{j=i+1}^{p} A_j$$

According to Granger's representation theorem when the coefficient matrix Π has reduced rank $r < k$, then there are $k \times r$ matrices α and β each with rank r so that Π = αβ'and β'y_t is I(0). Thereby, r represents the number of cointegrating relations and each column of β is the cointegrating vector. As explained below (see 5.2.4), the elements of α are the adjustment parameters of a VEC model. The rationale behind Johansen's method is to compute the Π matrix from an unrestricted VAR model and to test whether the restrictions implied by the reduced rank of Π can be rejected (EViews 2010: 685f.).

Before carrying out the test, it is necessary to make an assumption about the trend underlying the data used because one of five deterministic trend assumptions needs to be selected. Assumptions 1 and 5 are rarely used. Assumption 1 should be used when all series included in the test have zero mean. Assumption 5 assumes quadratic trends in the levels of the time series which is a very rare case that is not realistic for the vast majority of economic datasets. Assumption 2 should be used when none of the series have a trend and assumption 3 should be used when all trends are stochastic. Finally, assumption 4 should ba selected when some of the series included are trend stationary (EViews 2010: 687; Götze 2008; Nastansky and Strohe 2011; Schwarz 2010). A more detailed discussion of the five trend assumptions can be found in Johansen (1995: 80-84).

Two tests are used to determine the number of cointegrating relations r, the trace test and the maximum eigenvalue test (Lütkepohl 2005: 329). Thereby, one can proceed sequentially from $r = 0$ to $r = k - 1$ until the test procedures fail to reject.

The trace statistic tests the null hypothesis of r cointegrating relations against the alternative hypothesis of k cointegrating relations, where k is the number of endogenous variables, for $r = 0, 1, \ldots, k - 1$. The trace test statistic for the null hypothesis of r cointegrating relations is computed as follows:

[5.8] $$LR_{tr}(r \mid k) = -T \sum_{i=r+1}^{k} \log(1 - \lambda_i)$$

where λ_i is the i-th largest eigenvalue of the Π matrix.

The maximum eigenvalue test tests the null hypothesis of r cointegrating relations against the alternative hypothesis of $r + 1$ cointegrating relations. The maximum eigenvalue test statistic is computed as follows:

[5.9] $$LR_{\max}(r\,|\,r+1) = -T\log(1-\lambda_{r+1})$$
$$= LR_{tr}(r\,|\,k) - LR_{tr}(r+1\,|\,k)$$

For $r = 0, 1, \ldots, k-1$ (EViews 2010: 690f.; Patterson 2000: 621).

The results of both tests may differ occasionally (Constantin and Cernat-Gruici 2010; Johnston and DiNardo 1997: 302; Murray 2006: EXT 7-13). The main difference between both testing procedures lies in the different formulation of the alternative hypothesis (Nastansky and Strohe 2011).

In a model with n variables, there can be at most $n - 1$ linear independent cointegrating vectors. One can therefore distinguish between three cases:

1. $r = 0$: There are no cointegrating vectors and therefore, there is no cointegration.
2. $0 < r < n$: There are r cointegrating vectors/cointegrating relationships.
3. $r = n$: The matrix II is invertible and the the processes are all I(0). Hence, there is no cointegration.

When there are no cointegrating vectors, a VAR model in first diffences can be used. If there between $r = 1$ and $r = k - 1$ cointegrating relations, a VECM should be used. When there are $r = k$ cointegrating relations, a VAR model in levels should be used (Cottrell and Lucchetti 2012: 211; Harris 1995: 79; Patterson 2000: 619). The results of the Johansen test can be found in the appendix, section A3.

For an in-depth discussion of the Johansen test, the reader is referred to Darnell (1994: 203ff.)

5.2.4 Estimation of the VAR/VEC Model

After testing for cointegration, an unrestricted VAR or a VEC model can be built. The basic unrestricted VAR and VEC models have been set up in equations [5.5] and [5.6] and the basic methodology for both the unrestricted VAR and the VEC model has been explained in section 5.1.

To put it briefly, the VAR model is a system of unrestricted reduced form equations with endogenous variables. VEC models are an alternative to the basic VAR approach. They can be obtained from the levels VAR form [5.7] by subtracting $y_t - 1$ from both sides and rearranging terms (Lütkepohl 2004: 89). An error correction mechanism (ECM) specifies how two or more series of variables are related to one another via the series' short-term and long-run dynamics. VEC models can be applied to stationary and nonstationary data. However, they are usually used to analyse datasets with common stochastic trends or rather unit roots. ECMs created for multiple time series use an explicit representation of the trend(s) of such time series, thereby preventing the occurrence of spurious regressions accounting incorrectly for trends in the data and leading to incorrect inferences (Brandt and Williams 2007: 18; Granger and Newbold 1974; Hill 2008: 230f.).

The most common method used to estimate a VAR/VEC model is the Cholesky decomposition. When the Cholesky decomposition is used, the ordering of the variables in the model matters because this method of orthogonalisation prejudices a certain causal structure. Due to the triangular form of the matrix used for estimation, the first element or variable in the matrix is not affected by the other elements. The second variable, however, is influenced by the first but not by the remaining variables, while the third is influenced by the first and second variables and so on. That is, there is a recursive causal structure in terms of Wold (Breitung et al. 2004: 162f.).

When using the Cholesky decomposition for estimation, the ordering of the variables in the system is significant because the orthogonalisation and the estimates produced by VAR/VEC models may be influenced (Hamilton 1994: 322; Lütkepohl 1991: 155ff.). Therefore, different orderings should be tested and the results should be compared. If the results do not differ significantly, then the ordering becomes less meaningful (Canova 1999: 94; Cottrell and Lucchetti 2012; Möller 2004). Before opting for a certain ordering of the variables, a sensitivity analysis has been conducted with different orderings and the results have been compared. Although the results are quite similar in many cases, there are some cases where the results obtained differ significantly.

Another strategy that can be used to find the appropriate ordering for the study is to choose the ordering based on economic theory. According to Lütkepohl (2005: 61), “The ordering has to be such that the first variable is the only one with a potential immediate impact on all other variables.” In other words, when the focus of a study is on the impact of an exogenous shock in one variable (e.g. oil) on another specific variable in the model (e.g. steel exporting figures) then the ‘impacting’ variable or rather the most influncial variable should be placed first in the ordering while the ‘impacted’ variable should be placed second (Cottrell and Lucchetti 2012: 208f.; Frank and Garcia 2010). This way, the second ‘impacted’ variable (e.g. steel exporting figures) is only influenced by the ‘impacting’ variable (e.g. oil) but not by the other variables included in the model. This way, the second variable in the ordering is only impacted by the first. Therefore, the following ordering has been chosen for this study:

OIL QMT VALUE EXRA RGDP

where

OIL = crude oil price

QMT = steel exports to the U.S. in quantity metric tons

VALUE = steel export value

EXRA = exchange rates

RGDP = U.S. real GDP

Other studies examining the impact of oil price shocks on other variables by using a VAR/VEC model have also put the oil variable first in the ordering (e.g. Brown and Yücel 1999).

5.2.5 Testing for Autocorrelation

After the model has been estimated, it is necessary to test for autocorrelation to make sure the model is robust. According to Brandt and Williams (2007: 28), "VAR estimation is quite robust as long as the residuals are uncorrelated over time." That is, in order to make sure that the results obtained via VAR models are unbiased, it is essential to test for autocorrelation and to make sure that the residuals are uncorrelated over lagged time periods. Thereby, in VAR models correlated residuals across variables via contemporaneous effects must be expected by design. The Lagrange Multiplier (LM) test can be applied to test for serial correlation (5.2.5.1). Moreover, the VAR model can be overfitted to make sure that there is no autocorrelation in the residuals (5.2.5.2).

5.2.5.1 Lagrange Multiplier Test

In the univariate version of the LM test, the residuals from an OLS model are regressed on the lagged values of the dependent variable and the lagged values of the residuals. It is tested whether the regression coefficients for the lagged residuals in the unrestricted model are zero. In the multivariate version, two additional VARs are fitted, thereby using the residuals from a VAR(p) model of y_t.

The LM test for serially uncorrelated residuals is conducted in four steps:

1. An unrestricted artificial VAR is estimated, thereby allowing for the possibility that the residuals in the original VAR of y_t are correlated. This step is implemented by estimating the VAR

[5.10] $$e_t = y_{t-1}A_1 + \cdots + y_{t-p}A_p + e_{t-1}B_1 + \cdots + e_{t-h}B_h + u_t \,.$$

This VAR is formed by regressing the matrix of the residuals on lags 1 to p of y and lags 1 to h of the residuals from the original model.

2. A second artificial VAR is then estimated. This VAR is the restricted model where $B_1 = \ldots = B_h = 0$:

[5.11] $$e_t = y_{t-1}A_1 + \cdots + y_{t-p}A_p + u_t^R .$$

The second restricted model then corresponds to the null hypothesis that the original VAR's residuals are uncorrelated.

3. Next, the residual covariances for the two artificially created VAR residual models are constructed (equations [5.10] and [5.11])

[5.12] $$\tilde{\Sigma}_e = T^{-1}\sum_{t=1}^{T}\hat{u}_t'\hat{u}_t , \qquad \tilde{\Sigma}_R = T^{-1}\sum_{t=1}^{T}\hat{u}_t^{R}{}'\hat{u}_t^{R} .$$

Thereby, the first residual covariance matrix is estimated from the unrestricted artificial regression while the second residual covariance matrix is estimated from the second restricted artificial regression.

4. After steps one to three have been implemented, it is possible to compute the χ^2 LM test statistic in order to evaluate the presence of autocorrelation in the VAR residuals by

[5.13] $$LM = T[m - tr(\tilde{\Sigma}_e \tilde{\Sigma}_R^{-1})],$$

where

m = number of (endogenous) variables in the system

tr( ) = trace operation

The test statistic is distributed χ^2 with hm^2, that is, the number of restrictions on the restricted model's parameters under the null hypothesis of no autocorrelation in the residuals.[63]

It is noteworthy that Brüggemann et al. (2004) have shown that the LM test for serial correlation can also be used in conjunction with VECMs (Lütkepohl 2005: 346) and that the LM has also been applied by other studies (e.g. Asche et al. 1999) to test for autocorrelation.

5.2.5.2 Measures against Autocorrelation in the Residuals

If no autocorrelation is detected, the methods described below are used to analyse the estimates of the VAR/VEC model (see 5.3). If autocorrelation is detected, measures against the autocorrelation in the residuals must be taken. The method used by default to make sure that a VAR/VEC model has white noise residuals is to overfit the model. Thereby, additional lags are added until a lag length has been determined where no autocorrelation can be detected.

Although adding additional lags may lead to a certain degree of inefficiency, the consequences are still less dramatic when compared to the consequences of autocorrelation (Brandt and Williams 2007: 62).

5.3 VAR/VEC Analysis

The individual parameters of unrestricted VAR models and VECMs can hardly be interpreted meaningfully (Kirchgässner and Wolters 2007: 135). Therefore, other methods such as Granger causality tests (5.3.1), impulse response analysis (5.3.2) and variance decomposition analysis (5.3.3) are used to determine the relationships among the variables analysed. These methods are briefly introduced below.

5.3.1 Testing for Granger Causality

When testing for Granger causality (GC), the statistical usefulness of one variable for predicting another is tested by applying a hypothesis test. That is, GC assesses the relationships among time series in an unrestricted VAR model in that it observes the value of individual variables for explaining the other variables in the system (Granger 1969; Sims 1972).

For a bivariate VAR model with the variables Y_t and Z_t, the following applies:

[5.14] $$Y_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i Y_{t-i} + \sum_{i=1}^{p} \beta_i Z_{t-i} + \varepsilon_{1t} ,$$

[5.15] $$Z_t = \beta_0 + \sum_{i=1}^{p} \gamma_i Y_{t-i} + \sum_{i=1}^{p} \delta_i Z_{t-i} + \varepsilon_{2t} .$$

Based on this system of equations, GC can be defined as follows: “For linear models, Y_t Granger causes Z_t if the behaviour of the past Y_t can better predict the behaviour of Z_t than Z_t ’s past alone.” (Brandt and Williams 2007: 32)

The reverse is also true. For equations [5.14] and [5.15], in case Z_t Granger causes Y_t, the coefficients for Z_t ’s past value in Y_t are nonzero, or rather $\beta_i \neq 0$ for i = 1, 2,…, p. Likewise, in case Y_t Granger causes Z_t in the Z_t equation, the coefficients for the past values of Y_t are nonzero, or rather $\gamma_i \neq 0$ for i = 1, 2,…, p.

Testing for GC implies to assess whether the past values of a variable Y_{t-1},…, Y_{t-p}, can predict the present value of variable Z_t in a VAR. Formal GC testing is then carried out by applying an F test or a χ^2 test for the joint hypothesis that the possible causal variable *does not cause the other variable*. As defined above, the H_0 hypothesis of the test is one of *noncausality*.

For the GC test, H_0 is specified as follows:

H_0 : Granger noncausality Z_t does not predict Y_t if

$$\beta_1 = \beta_2 = \cdots = \beta_p = 0.$$

H_A : Granger causality Z_t does predict Y_t if

$$\beta_1 \neq 0,\ \beta_2 \neq 0, \ldots,\ or\ \beta_p \neq 0.$$

The Granger causality concept presumes all tested time series to be stationary. However, economic time series are often nonstationary. In this study, each sample contains at least two variables with unit roots. In the presence of unit roots, Granger causality estimates may be biased against the null hypothesis (Brandt and Williams 2007: 66f.; Hamilton 1994: 554) and spurious Granger causality may occur. The test results would then be biased (He and Maekawa 2001; Schulze 2004).

To prevent spurious Granger causality in the presence of unit roots, the Toda/Yamamoto procedure can be applied (Giles 2011a, b; Lütkepohl 2005: 318; Toda and Yamamoto 1995). The testing procedure works as follows: After determining the optimal lag length *k*, a *(k + d_{max})*th-order VAR model is estimated where d_{max} is the suspected maximal order of integration. That is, when the highest order of integration in the model is I(1), then $d_{max} = 1$. The coefficient matrices of the last d_{max} lagged vectors in the model are then ignored because they are considered as zeros. Linear or nonlinear restrictions on the first *k* coefficient matrices can then be tested by applying the standard asymptotic theory (Kirchgässner and Wolters 2007: 232; Toda and Yamamoto 1995).

5.3.2 Impulse Response Analysis

Section 5.3.2 describes the impulse response analysis for unrestricted VAR models (5.3.2.1) and VEC models (5.3.2.2) and the estimation of error bands for impulse responses (5.3.2.3).

5.3.2.1 Impulse Response Analysis for Unrestricted VAR Models

Impulse response analysis used to identify dynamic causal relationships among variables (Brandt and Williams 2007: 36). When one variable reacts to an impulse in another variable, the latter may be called causal for the former. This type of causality can be analysed by tracing out the effect of an exogenous shock in one variable on another variable (Lütkepohl 2005: 51). Typically, the magnitude of the innovation is one standard deviation of the residuals in the VAR model. Then, the initial responses are traced out as functions of time (Brandt and Williams 2007: 41).

When the process y_t in an unrestricted VAR model is I(0), the response to shocks in the variables of a given system can best be seen in the Wold moving average (MA) representation

[5.16] $$y_t = \Phi_0 u_t + \Phi_1 u_{t-1} + \Phi_2 u_{t-2} + \cdots,$$

where $\Phi_0 = \mathrm{I}_K$ and the

[5.17] $$\Phi_s = \sum_{j=1}^{s} \Phi_{s-j} \mathrm{A}_j, \qquad s = 1, 2, \ldots ,$$

can be estimated recursively from the reduced-form coefficients of a VAR in levels.The coefficients of the MA representation then reflect the responses to impulses introduced into the system. The (i, j)th elements of the matrices Φ_s are viewed as a function of s. They trace out the expected response of $y_{i,\ t+s}$ to a unit change in y_{jt}, thereby holding constant the past values of y_t. Because the change in y_{it} given $\{y_{t-1}, y_{t-2}, \ldots\}$, is measured by innovation u_{it}, the elements of Φ_s represent the impulse responses of the elements of y_t with respect to the innovations u_t. For an unrestricted stationary VAR, $\Phi_s \rightarrow 0$ as $s \rightarrow \infty$. That is, the response to the impulse is transitory and vanishes over time.

The analysis of impulse responses has been criticised because the underlying shocks are unlikely to occur in isolation when the components of u_t are instantaneously correlated or rather when Σ_u is not diagonal. Hence, orthogonal impulses, which can be calculated by using a Cholesky decomposition of the covariance matrix Σ_u, are used by default. When B is a lower triangular matrix so that $\Sigma_u = BB'$, the orthogonalised shocks are given by $\varepsilon_t = B^{-1}u_t$. Therefore, the following can be obtained form [5.16]:

[5.18] $$y_t = \Psi_0 \varepsilon_t + \Psi_1 \varepsilon_{t-1} + \cdots,$$

where $\Psi_i = \Phi_i B$ $(i = 0, 1, 2, \ldots)$. Here, $\Psi_0 = B$ is lower triangular. Hence, an ε shock in the first variable has an instantaneous effect on all other variables in the system while a shock in the second variable cannot have an instantaneous effect on the first variable, the third variable cannot have an instantaneous effect on the first and the second variable, and so on (see 5.2.4). Given that the ε shocks in the Wold causal chain are instantaneously uncorrelated or orthogonal, the impulse responses are often referred to as orthogonalised impulse responses (Breitung et al. 2004: 165f.).

When using the Cholesky decomposition, the ordering of the variables in the equations of the VAR model is crucial. According to Brandt and Williams (2007: 91), "changing the ordering alters the normalisation of the Cholesky decomposition and the order in which the equations are shocked in the computation of the moving average response." If the correlations among the residuals are rather low, the ordering is not a decisive factor when computing the impulse responses. When there is strong correlation among the series, however, the ordering affects the interpretation of the results.

In case the innovations in the variables in the system are uncorrelated, the choice about how to compute the contemporaneous correlations is not of primary importance. When the contemporaneous correlations are highly correlated, however, different approaches should be taken into consideration:

1. In case not all of the variables in the VAR model are highly contemporaneously correlated, the subset of correlated variables should be placed together in the Cholesky ordering. While not too much can be learned about the impacts of the contemporaneously correlated variables on each other, more can be learned about their impact on the other variables in the system.
2. A sensitivity analysis can be conducted to see how the dynamics of the system's impulse responses are altered by the different choices regarding the contemporaneous orderings. (Brandt and Williams 2007: 37ff.).

As described above, the IRFs indicate how a VAR/VEC model reacts to a specific impulse (Möller 2004). In this case, the response of steel exports from different countries to the U.S. in quantity metric tons to a shock in real oil prices is estimated, thereby using a Cholesky one-standard deviation as a shock introduced into the system. The responses to the shock, which is introduced into the system in period one, are then calculated for a fifteen month time period. The focus of the analysis is on the immediate reaction to the shock until the line representing the impulse responses crosses the zero line and the shock starts to die down over time. The IRFs are displayed graphically (see appendix, section A4) and in tabular form (see chapter 6).

5.3.2.2 Impulse Response Analysis for VEC Models

If cointegration between I(1) variables is present but not imposed in estimation, the result is both misspecification error and bias in the computation of the impulse responses. Therefore, the VEC model should be used for estimation when there is cointegration among trending variables (Stevans and Sessions 2010).

When computing impulse responses for VEC models, the main obstacle is the fact that in the presence of cointegrated I(1) variables, the long-run dynamic multiplier is undefined. As a consequence, the Wold representation does not exist for cointegrated processes (Masten 2011; Stevans and Sessions 2010). However, according to Lütkepohl et al. (2006: 28), “although the Wold representation does not exist for nonstationary cointegrated processes, the Φ_s impulse response matrices can be computed in the same way for nonstationary processes. Thus the forecast error impulse responses are available even if some variables are not I(0).”

The presence of unit roots prevents the inversion of a levels VAR model to an MA representation. However, Sims et al. (1990) and Lütkepohl and Reimers (1992) have shown that impulse responses for VECMs can be estimated based on a *levels* VAR model (Jang 2001; Lütkepohl and Krätzig 2005: 35). The algorithm used to convert the VECM into a VAR in levels can be found in Lütkepohl and Reimers (1992) and Jang (2001). According to Lütkepohl and Reimers (1992), after the transformation, the impulse responses can be estimated recursively by

[5.19] $$\Psi_m = \sum_{l=1}^{p} \Psi_{m-l} \mathrm{A}_l, \qquad m = 1, 2, 3, \cdots$$

[5.20] $$\Phi_m = \Psi_m \Gamma_0,$$

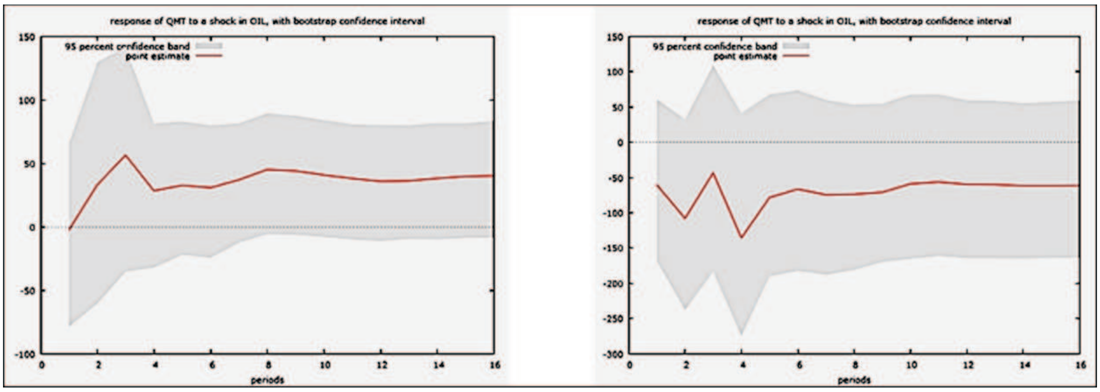
where $\Psi_0 = I_n$, $\Phi_m = (\phi_{m,ij})$, and $\phi_{m,ij}$ is an m-step response of the i_{th} variable to the j_{th} innovation (Jang 2001: 14f.).

Therefore, impulse response analysis is also valuable in cointegrated systems because in principle it can be used in the same way as for stationary VARs (Lütkepohl and Reimers 1992; Lütkepohl 2005: 321).

Nevertheless, there is one significant difference that needs to be considered when interpreting impulse responses of cointegrated systems. The impulse responses generated for a stationary VAR converge to zero as time (s) increases. However, impulse responses generated for a system with cointegrated I(1) variables in some cases may not converge to zero as s increases (Frank and Garcia 2010; Lütkepohl 2005: 262ff.). This essentially means that a one-time impulse may have a permanent effect in the sense that it shifts the system to a new equilibrium (Breitung et al. 2004: 168; Lütkepohl and Reimers 1992).

Concluding, it is possible to estimate impulse response functions for cointegrated systems although the statistics converge more slowly than in stationary systems and in some cases have a permanent effect and do not go back to equilibrium (Kirchgässner and Wolters 2007: 233). Therefore, impulse responses which have a permanent effect have not been included in the analysis. Figure 5.2 shows examples of impulse responses with positive/negative permanent effects.

Figure 5.2 Impulse Responses with Positive/Negative Permanent Effects



However, the impulse responses without permanent effects which have been included in the study can be interpreted in the same way as the estimates from an unrestricted VAR in levels (Kirchgässner and Wolters 2007: 233).

The impulse response and variance decomposition estimates are computed by using EViews. The error bands for the impulse responses are computed by using GRETL. Both econometric packages calculate the estimates by transforming the VECM into a VAR in levels as described above. Therefore, the estimates created by EViews and GRETL are identical (EViews.com 2013).

5.3.2.3 Error Bands for Impulse Responses

In order to determine whether the impulses produced are statistically significant, error bands or bootstrap confidence intervals[64] are produced. The standard approach for the estimation of error bands is based on the construction of the following interval:

[5.21] $$\hat{c}_{ij}(t) \pm \delta_{ij}(t)$$

In the interval, $\delta_{ij}(t)$ are functions determining the upper and lower bounds of the confidence interval for some 100 (1- α) region for the response at time $t, c_{ij}(t)$ .These bounds are by default presented graphically by plotting the functions $\hat{c}_{ij}(t) - \delta_{ij}(t)$, $\hat{c}_{ij}$, and $\hat{c}_{ij}(t) + \delta_{ij}(t)$ as functions of *t*.

There are different calculation methods for the estimation of error bands and the functions $\delta_{ij}(t)$. The most accepted method, however, is to conduct a simulation in order to estimate a sample of the responses and to summarise this sample. In this context, it is common practice to compute a Monte Carlo sample[65] from the (posterior) distribution of the VAR coefficients.

When applying this method, a (posterior) sample of the VAR parameters is created. VAR coefficients are multivariate normal with mean $B \sim MVN(\hat{B}, \sum \otimes (X'X)^{-1})$. The inverse of the posterior estimates of the residual covariance, $\sum^{-1}$, has a so-called Wishart distribution[66] with $\sum^{-1} \sim$ Wishart (S, T) where $\overline{S}$ is the sample estimate of $\hat{\sum}^{-1}$. Based on these facts, a sample of the VAR impulse responses can be generated as follows:

1. $\sum^{-1}$ is drawn from the inverse Wishart distribution.
2. A draw of the autoregressive coefficients must be taken from $B \sim MVN(\hat{B}, \sum \otimes (X'X)^{-1})$ by using Σ from step 1.
3. The draw from steps 1 and 2 can then be used to calculate a set of impulse responses.
4. The computed responses from step 3 must be saved.
5. Steps 1 to 4 need to be repeated *N* times, where *N* provides the appropriate precision about the responses of interest.

The *N* sets of $m \times m \times s$ responses are then summarised to provide an estimate of the impulse responses' variance. Thereby, the number of samples (*N*) used typically lies between 1,000 and 5,000, and is dependent on the level of precision necessary and the scale of the data.

A normal approximation to the average $\hat{c}_{ij}$ can then be calculated from this sample:

[5.22] $$\hat{c}_{ij}(t) \pm z_\alpha \sigma_{ij}(t),$$

where z_α stands for the normal probability density quantiles and $\sigma_{ij}(t)$ is the standard deviation of $c_{ij}(t)$, the response of variable *i* to shock *j* at time *t* (Brandt and Williams 2007: 41ff.).

Impulse responses with confidence intervals not containing zero are considered to be statistically significant while responses whose confidence intervals include zero for the time horizon of the responses are not statistically significant.

There are different opinions among econometricians which error bands shall be used to determine the statistical significance of the estimates. Exemplarily, Sims and Zha (1995) prefer to use "intervals with coverage or posterior probability .68 (one standard error in the Gaussian case). In much applied work .90, .95 or .99 probability intervals are used. We think … it would be a good idea to make one-standard-error intervals the norm, as they are likely to be closer to the relevant range of uncertainty." In yet another article, Sims and Zha (1999) also opt for 68% error bands since they provide a more accurate summary of the responses central tendency while Brandt and Williams (2007: 91ff.) use different error bands for their research. Here, multiple error bands (68%, 90%, 95%) are used to determine the statistical significance of the estimates.

5.3.3 Variance Decomposition Analysis

The focus of the variance decomposition (VD) method is on determining how much of the variation of each variable in the system is due to dynamic changes in the other variables used in the analysis. The VD method measures how much of the forecast error in the variables is due to variable X and how much can be attributed to variable Y. That is, by using VD testing, it is possible to determine how changes/innovations in one variable lead to change in another. Therefore, the more of a variable's X forecast errors can be attributed to another variable Y, the more important Y is for predicting or explaining X.

Variance decomposition is carried out by calculating the variance of a VAR model's forecast errors. It is necessary to use the VMA representation of the VAR for this calculation. The forecast errors for a VAR system at period s can be estimated by using the following equation:

[5.23] $$y_{t+s} - \hat{y}_{t+s} = e_{t+s} + C_1 e_{t+s-1} + C_2 e_{t+s-2} + \cdots + C_{s-1} e_{t+1} .$$

The left-hand side of equation [5.23] represents the difference between the observed value of the endogenous variables' vector at time $t + s$ and the predicted values from the VAR while on the right-hand side, there is the VMA representation of the forecast errors over the actual period $T = s$ back to period $s – 1$. Equation [5.23] mathematically describes how the present innovations in the VAR model are functions of the model's past innovations. The moving average coefficients C_ℓ are defined for the VMA representation of the VAR model. Equation [5.23] then shows that the innovations in the VAR model are a function of their own past value in the VMA representation.

The forecast error variance in equation [5.23] is

[5.24] $$\begin{aligned} V(y_{t+s} - \hat{y}_{t+s}) &= E\left[(y_{t+s} - \hat{y}_{t+s})'(y_{t+s} - \hat{y}_{t+s})\right] \\ &= \Sigma + C_1 \Sigma C'_1 + C_2 \Sigma C'_2 + \cdots + C_{s-1} \Sigma C'_{s-1} , \end{aligned}$$

where $\Sigma = E\left[e'_t \, e_t\right]$ represents the covariance of the forecast errors at period t.

Orthogonalised forecast innovations can be expressed as follows:

[5.25] $$e_t = u_t A_0^{-1} = u_{1t} a_1 + u_{2t} a_2 + \cdots + u_{mt} a_m ,$$

where $u_t = (u_{1t}, u_{2t} \ldots u_{mt})$, a_i represents the ith column of the decomposition of the covariance of the residuals, $\Sigma = A_0^{-1}{}' A_0^{-1}$. By default, this is a Cholesky decomposition of the error covariance matrix where matrix A_0^{-1} accounts for the contemporaneous correlations among the innovations. Due to the fact that the matrix is by definition a lower triangular matrix, the orthogonalised residuals stand for a specific pattern of linear combinations of the residuals.

The orthogonalisation procedure can be used for the decomposition of the forecast error variance with respect to time and each variable. This is typically done by replacing the residual covariance Σ in equation [5.24] with the orthogonalised residual covariance in equation [5.25]. The orthogonalised variances of the forecast errors in equation [5.24] can then be expressed as follows:

[5.26] $$V(y_{t+s} - \hat{y}_{t+s}) = \sum_{i=1}^{m} a_i a'_i + C_1 a_i a'_i C'_1 + C_2 a_i a'_i C'_2 + \cdots + C_{s-1} a_i a'_i C'_{s-1} .$$

Equation [5.26] represents the moving average representation rescaled into the orthogonalised residuals. The variance matrix can then be calculated for the s forecast horizon periods where the ith row of the matrix stands for the variance of that equation and where the jth column represents the covariance which is explained for the ith row variable. The elements of the s forecast variance matrices therefore give information regarding the extent to which the variation in each variable can be explained by its own innovation and the extent to which the variation is due to variation in the innovations of the other variables included in the system (Brandt and Williams 2007: 45ff.).

According to Lütkepohl and Reimers (1992: 56), variance decompositions “are also available for cointegrated systems and are computed using the same formulas as in the stationary case.” That is, VD estimation for VEC models is based on the levels VAR form analogous to the estimation of impulse responses (Kirchgässner and Wolters 2007: 233; Lütkepohl 2005: 264) (see 5.3.2.2).

Decomposition estimates are calculated for a time period of 15 months. The estimates are displayed graphically (see appendix, section A4) and in tabular form (see chapter 6).

6 Analysis II: Econometric Analysis of U.S. Steel Imports

Chapter 6 analyses the econometric estimates obtained by implementing the methodological approach described in chapter 5. The chapter is structured as follows: Section 6.1 describes the analytic procedure used. The subsequent sections then analyse the econometric estimates. The analysis has been subdivided into three parts. Section 6.2 analyses the econometric estimates for steel exports to the U.S. for steel exporting countries. Sections 6.3 and 6.4 then analyse the estimates for steel exports to the U.S. for steel exporting regions and for steel product categories. Section 6.5 concludes.

6.1 Analytic Procedure

Section 6.1 describes the analytic procedure used for the analysis of the econometric estimates for steel exporting countries (see 6.2) and regions (see 6.3).[67] That is, the purpose of the section is to familiarise the reader with the analytical approach applied below.

The analysis for each steel exporting country/region has been divided into six sub-sections:

1. Impulse Response Analysis
2. Variance Decomposition Analysis
3. Granger Causality Analysis
4. Trade Distance Analysis
5. Competitiveness Analysis
6. Conclusion

The procedures applied in sub-sections 1-5 are described below. Section 6.1.1 first explains the way of proceeding adopted for the analysis of the impulse response, variance decomposition, and Granger causality estimates in sub-sections 1-3. Section 6.1.2 then describes the trade distance analysis in sub-section 4. Thereby, the criteria used for the selection of bilateral trade distances and the computation of the trade distances are also explained. Finally, the rationale behind the selection of the macroeconomic key performance indicators used for the competitiveness analysis in sub-section 5 is explained in section 6.1.3.

6.1.1 Analysis of Econometric Estimates

Section 6.1.1 describes the procedure applied for the analysis of the impulse response (6.1.1.1), variance decomposition (6.1.1.2) and Granger causality estimates (6.1.1.3).

Analytical Structure

1. ***Impulse Response Analysis***
2. ***Variance Decomposition Analysis***
3. ***Granger Causality Analysis***
4. Trade Distance Analysis
5. Competitiveness Analysis
6. Conclusion

6.1.1.1 Impulse Response Analysis

The impulse responses estimated are interpreted in the first sub-section of the analysis for each steel exporting country/region. Thereby, the statistical significance of the impulse responses is estimated by using 68%, 90%, and 95% error bands. Moreover, the impulse response section describes the length of the immediate reaction of steel exports to a one-standard deviation shock in oil prices, and the peak of the immediate reaction. The graphical display of the impulse responses including error bands can be found in the appendix, section A4.

6.1.1.2 Variance Decomposition Analysis

The variance decomposition estimates are interpreted in the second sub-section of the analysis for any steel exporting country/region selected. Thereby, the variance decomposition estimates are classified into five categories which indicate whether the variation in the steel export variable that can be explained by variation in the oil price variable is very low, low, moderate, high or very high:

- $0\% \leq$ very low $< 5\%$
- $5\% \leq$ low $< 10\%$
- $10\% \leq$ moderate $< 20\%$
- $20\% \leq$ high $< 30\%$
- very high $> 30\%$

The graphical display of the variance decomposition estimates can be found in the appendix, section A4.

6.1.1.3 Granger Causality Analysis

The Granger causality test results are analysed in the third sub-section of the analysis for every steel exporting country/region. The estimates show whether steel exports to the U.S. depend on past oil price values. They are evaluated in terms of significance at the 1%, 5%, and 10% level.

6.1.2 Distance of Trade – Upstream and Downstream Transport Costs

Trade distances are used in the fourth sub-section of the analysis for each steel exporting country/region.

Analytical Structure

1. Impulse Response Analysis
2. Variance Decomposition Analysis
3. Granger Causality Analysis
4. ***Trade Distance Analysis***
5. Competitiveness Analysis
6. Conclusion

In previous studies, the distance of trade has been regularly used as a proxy for transport costs (see 3.3.1). In this study, oil prices are used as a proxy for bunker fuel costs (see 4.1.3). As bunker fuel costs increase with distance, upstream and downstream trade distances are a reasonable addition for the analysis because countries whose steel exports to the U.S. are overproportionally affected by fuel costs due to their geographic location can be identified.

Section 6.1.2 proceeds as follows: Section 6.1.2.1 explains why maritime upstream trade distances between the main exporters of iron ore and coking coal and the countries/regions exporting steel to the U.S. are used in the analysis. The section also describes the basis on which the upstream trade distances were calculated and how they were calculated. Section 6.1.2.2 then explains the rationale behind the use of maritime downstream trade distances between steel exporting countries/regions and the United States. Finally, section 6.1.2.3 defines the categories into which the estimated trade distances have been classified.

6.1.2.1 Upstream Trade Distances

Steel production requires a number of steelmaking raw materials some of which are distributed unevenly between countries and regions. Table 6.1 gives an overview of the materials used in the steel production process, their properties in steel, and the global steel industry's relative share of use.

Depending on factor endowments and geographic location, the steel industries of countries can face substantial upstream transport costs or bunker fuel costs. In the respective analyses of the steel exporting countries/regions, the coking coal and iron ore trades are used to illustrate the upstream transport fuel costs the different steel industries analysed are confronted with. For that purpose, bilateral trade distances between the most important exporters of both raw materials and the steel exporting countries included in the analysis have been calculated. The selection and computation of these trade distances are described and justified below.

Table 6.1 Steelmaking Raw Materials, Properties, and Share of Use

Raw Material	Properties in Steel	Steel Industry's Share of Use (in %)
Iron Ore	Provides the ferrous content in the steel	98
Coking Coal	Produces coke, heat source and reducing agent in BF	> 80
Ferrous Scrap	Main elements for EAF-steel, combined with iron in BOF to reduce levels of heat	100
Manganese	Desulpherises and as alloying element for strength	90
Silicon	Used to de-oxidise steel	60
Nickel	Anti-corrosion (nickel content in stainless steel 8-10%)	60
Chromium	Anti-corrosion (in stainless steel, average content 18%)	75
Zinc	Used to galvanise steel (enhances corrosion resistance)	60
Tin	Brings protective coating to steel (food and drink cans)	20
Molybdenum	Resistance to heat, corrosion (high-end steel). Brings weldability to steel (construction steel)	60
Vanadium	Brings extreme hardness to steel (high-strength steel)	85
Tungsten	Brings extreme hardness to steel (high-speed steel)	20

Source: OECD 2012, Table 1

Selection and Calculation of Coking Coal Upstream Trade Distances for the Analysis

Tables 6.2 and 6.3 specify the main coking coal importing and exporting countries.
Although coking coal is mined in many countries, the number of countries exporting considerable volumes of coking coal is rather small. Table 6.3 shows that in 2010 (2011), eleven (ten) countries accounted for 270Mt of 271Mt (274.9Mt of 276Mt) or 99.6% (99.6%) of the global coking coal trade.

Table 6.2 Coking Coal Importers (in Mt)

Country	2004	2005	2006	2007	2008	2009	2010	2011
Brazil	n.a.	15.0	19.0	n.a.	n.a.	n.a.	12.0	12.0
China	n.a.	7.0	9.0	6.0	11.0	n.a.	48.0	38.0
Germany	7.0	7.0	9.0	10.0	9.0	n.a.	8.0	9.0
India	n.a.	20.0	19.0	23.0	29.0	n.a.	30.0	19.0
Italy	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	5.0	5.6
Japan	86.0	63.0	73.0	54.0	58.0	n.a.	58.0	54.0
South Korea	21.0	21.0	20.0	23.0	24.0	n.a.	28.0	32.0
Taiwan	7.0	5.0	6.0	8.0	6.0	n.a.	n.a.	4.0
Turkey	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	7.0	4.6
Ukraine	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	10.0	7.0
United Kingdom	6.0	7.0	7.0	7.0	7.0	n.a.	6.0	6.0
Other	87.0	82.0	60.0	116.0	118.0	211.0	59.0	84.8
Total	214.0	227.0	222.0	247.0	262.0	211.0	271.0	276.0

Sources: WCA n.d.a, b, c; WCI 2005, 2006, 2007, 2008, 2009; OECD 2012

Table 6.3 Coking Coal Exporters (in Mt)

Country	2004	2005	2006	2007	2008	2009	2010	2011
Australia	112.0	125.0	121.0	132.0	137.0	n.a.	155.0	140.0
Canada	26.0	26.0	n.a.	n.a.	n.a.	n.a.	27.0	28.0
China	6.0	6.0	4.0	3.0	4.0	n.a.	n.a.	3.0
Colombia	1.0	0.1	-	-	-	n.a.	1.0	-
Czech Republic	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	4.0	2.1
Indonesia	17.0	19.0	25.0	31.0	30.0	n.a.	2.0	-
Kazakhstan	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	1.0
Mongolia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	11.0	20.0
New Zealand	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	2.0	2.1
Poland	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	2.0	1.7
Russia	14.0	12.0	10.0	15.0	15.0	n.a.	14.0	14.0
South Africa	3.0	1.0	1.0	1.0	1.0	n.a.	1.0	-
United States	24.0	26.0	25.0	29.0	39.0	n.a.	51.0	63.0
Other	11.0	11.9	36.0	36.0	36.0	21.0	1.0	1.1
Total	214.0	227.0	222.0	247.0	262.0	211.0	271.0	276.0

Sources: ACA n.d.; WCA n.d.a, b, c; WCI 2005, 2006, 2007, 2008, 2009

Australia and the U.S. are the two largest exporters of coking coal. Table 6.4 shows that Australia accounted for 50%-57% of total coking coal exports between 2004 and 2011 while the U.S. accounted for 11%-23% of total exports with tendency to rise.

Table 6.4 Coking Coal Exports of Australia and the U.S.

Relative Share of Coking Coal Exports (in Mt)			
	Australia	United States	Σ
2004	52.3%	11.2%	63.5%
2005	55.1%	11.5%	66.5%
2006	54.5%	11.3%	65.8%
2007	53.4%	11.7%	65.2%
2008	52.3%	14.9%	67.2%
2009	n.a.	n.a.	n.a.
2010	57.2%	18.8%	76.0%
2011	50.7%	22.8%	73.6%

Source: Author's calculations; data: see tables 6.2 and 6.3

Taken together, both countries accounted for roughly two thirds of total exports between 2004 and 2008 and for about three quarters of total exports in 2010 and 2011. Therefore, most coking coal net importers source coking coal from Australia and/or the United States. This makes both countries a good proxy for the estimation of coking coal trade distances. Hence, Australia and the U.S. have been selected as exporting countries for the calculation of the coking coal upstream trade distances used for the analysis.

In 2010, six seaports on the Gulf Coast and the East Coast accounted for 94% of total U.S. coal exports, whereby 68% of total exports consisted of coking coal. Port Norfolk, Virginia (East Coast) is the largest coal export facility in the U.S. accounting for about 30% of total coking coal exports in 2010. Port Mobile, Alabama is the largest coal export facility on the

Gulf Coast with about 10% of total coking coal exports in 2010 (EIA 2011d). Both ports are therefore good proxies to estimate coking coal trade distances between the U.S. and its trading partners.

The two largest (coking) coal export handling operations in the world are located at the port of Newcastle (New South Wales), Australia (ACA n.d.b) which makes Newcastle a good proxy to estimate coking coal trade distances between Australia and its trading partners.

At the other end, at least one major port of destination has been chosen for each coking coal importing country included in the analysis based on port size.[68]

The distance between the ports of departure and destination has been estimated by using a port distance calculator[69] (vesseltracker.com n.d.). No trade distances have been calculated for coking coal net exporting countries because they do not depend on coking coal imports. This gives the steel industries of coking coal net exporting countries a comparative advantage based on factor endowments which is considered in the subsequent analysis.

Selection and Calculation of Iron Ore Upstream Trade Distances for the Analysis

The international iron ore market is even more concentrated than the coking coal market. Although iron ore is mined in about 50 countries, Australia, Brazil, China and India actually account for 84% of global iron ore production (OECD 2012).

In 2011 Australia (38%) and Brazil (30.2%) accounted for more than two thirds of total iron ore exports (see table 6.5) with tendency to rise (Australian exports increased by 8.9% in 2011 and Brazilian exports were up 12.1%.) (OECD 2012; USGS n.d.; WCI n.d.a,b). Therefore, most iron ore net importers source iron ore from Australia and/or Brazil. This makes both countries a good proxy for the estimation of iron ore trade distances.

Table 6.5 Iron Ore Exports 2011

Rank	Country	Exports	
		in MMT	in %
1	Australia	438.8	38.0
2	Brazil	348.6	30.2
3	India	78.8	6.8
4	South Africa	52.2	4.5
5	Ukraine	34.1	3.0
	Rest of the world	202.5	17.5
	World total	1,155.0	100.0

Source: OECD 2012, table 5; percentages: Author's calculations

Port Hedland is located in the resource-rich Pilbara region in north-west Australia and is a large volume bulk mineral export port where iron ore makes up the vast majority of cargo shipped. With Port Walkott and Port Dampier located nearby, a total of three large ports in the region are used to ship a significant share of Australia's total iron ore exports. Therefore, port Hedland is used as port of departure for iron ore upstream trade distance calculation.

Port Ponta Ubu includes one of Brazil's largest iron ore loading terminals and is known for very efficient loading operations (Wilhelmsen Ships Service 2008). Therefore, Ponta Ubu is also used as port of departure for iron ore trade distance calculation.

As for the calculation of coking coal trade distances, a port distance calculator has also been used for estimating iron ore trade distances between the ports of departure and arrival. Iron ore net exporting countries (reference years: 2007, 2008) have been excluded because they do not depend on iron ore imports. This gives the steel industries of net exporting countries a comparative advantage based on factor endowments.[70]

6.1.2.2 Downstream Trade Distances

In order to get an impression of the trade distances involved for exporting steel to the United States, bilateral downstream trade distances have been calculated between the U.S. and the steel exporting countries included in the analysis.

The ports of Long Beach (West Coast), New York (East Coast) and New Orleans (Gulf Coast) are destinations for significant volumes of U.S. steel imports (WPS n.d.a,b,c) and have therefore been selected as ports of arrival for steel trade distance calculation. The ports of departure in the exporting countries have been selected based on port size (e.g. Rotterdam for the Netherlands and Hamburg for Germany).

6.1.2.3 Classification of Trade Distances

The bilateral upstream and downstream trade distances calculated have been classified into the following categories:

- very short distance trade: 0km – 1,999km
- short-distance trade: 2,000km – 3,999km
- moderate-distance trade: 4,000km – 5,999km
- long-distance trade: 6,000km – 9,999km
- very long distance trade: ≥ 10,000km

6.1.3 Macroeconomic Key Performance Indicators

In the fifth sub-section of the analysis for each steel exporting country/region, makroeconomic key performance indicators are used to explain why the steel industries in some countries are better able to absorb high oil prices than others.

<u>Analytical Structure</u>

1. Impulse Response Analysis
2. Variance Decomposition Analysis
3. Granger Causality Analysis
4. Trade Distance Analysis
5. ***Competitiveness Analysis***
6. Conclusion

The Global Competitiveness Report (GCR) is published annually by the World Economic Forum. The GCR of 2008/2009 analyses the competitiveness of 134 countries by using 12 pillars of economic competitiveness. Each pillar includes several sub-criteria for the evaluation of a country's competitiveness (Schwab and Porter 2008).

The GCR publishes rankings for all steel exporting countries included in the analysis for each of the sub-criteria so that the relative competitiveness of each country can be compared for each performance indicator selected. Moreover, the report also states whether the position of a country in the ranking indicates a competitive advantage or disadvantage. The rankings for the sub-criteria are summarised by the Global Competitiveness Index (GCI). The GCI is also a ranking and expresses the overall competitiveness of an economy relative to the economies of the other countries included in the report.

In addition to the GCI, a number of sub-criteria have been selected from the GCR of 2008/2009 to compare the competitiveness of the steel exporting countries/regions. The criteria selected include the overall infrastructure and the port infrastructure of each country. The importance of (port) infrastructure for international trade is described in section 3.3.2. Moreover, the domestic and foreign market size[71] of each country are used as a proxy for economies of scale. The importance of economies of scale[72] for the bulk trades (and therefore for the coking coal, iron ore and steel trades) is described in section 3.3.3.

Finally, the GCR also provides information on the stage of development[73] of each country and discriminates between countries that are

1. factor-driven (= developing country)
2. efficiency-driven (= industrialising country)
3. innovation-driven (= industrialised country).[74]

The stage of development can be a helpful indicator for the analysis because countries in the same stage of development often have similarities in terms of comparative advantage, for example when it comes to labour costs. As economies move along the path of development, wages tend to rise, thereby reducing their comparative advantage.

Finally, data on wages[75] and compensation costs[76] have been collected from the U.S. Bureau of Labor Statistics (BLS) and have been included in the analysis because differences in wages and compensation costs play an essential role for the shape of international trade. This is because companies/industries often relocate based on cheap (or skilled) labour. The BLS publishes data on manufacturing wages[77] for 30 of the 64 steel exporting countries included in the analysis. The institution also publishes data on hourly compensation costs for primary metal manufacturing[78] (25 of 64 countries) and for fabricated product manufacturing[79] (24 of 64 countries). Although data on labour costs are not available for all 64 countries, the data published at least give an indication of the wage and compensation cost differences between certain countries/regions.

6.1.4 Summary

Section 6.1 introduces the reader to the analytical procedure applied below. The analysis for each steel exporting country/region has been divided into six sub-sections. After reading through section 6.1, it should now be clear how the econometric estimates in sub-sections one (impulse response analysis), two (variance decomposition analysis) and three (Granger causality analysis) are assessed (see 6.1.1). Moreover, the rationale behind the calculation and use of bilateral maritime upstream and downstream trade distances in sub-section four is explained (see 6.1.2). Finally, the reasons for using macroeconomic performance indicators for the analysis in sub-section five for each steel exporting country/region are described.

The remarks in section 6.1 regarding the analytical procedure used provide the guideline for the understanding of the subsequent analysis and the reader is encouraged to read the respective passages again should any questions regarding the way of analytical proceeding come up while reading through the analysis.

Finally, it needs to be mentioned that the econometric estimates (impulse responses, variance decomposition, Granger causality) analysed in sub-sections 1-3 of the analysis for each steel exporting country/region are summarised throughout the text in tabular form. The data on bilateral upstream and downstream trade distances and key performance indicators (overall infrastructure, port infrastructure, domestic market size, foreign market size, manufacturing wages, hourly compensation costs) included in sub-sections 4-5 throughout the text can be found in tabular form in the appendix, section A5.

6.2 Analysis of Steel Exports to the U.S. by Country

In section 6.2, the econometric estimates for the steel exporting countries from the European Union (6.2.1), other Europe (6.2.2), the C.I.S. (6.2.3), North America (6.2.4), South America (6.2.5), Africa (6.2.6), the Middle East (6.2.7), Asia (6.2.8), and Oceania (6.2.9) are analysed and put in perspective.

6.2.1 European Union

Section 6.2.1 analyses the econometric estimates for 23 of 27 members of the European Union. Prior to the analysis of the estimates for each country, the estimates for the EU-member countries are listed in tabular form to facilitate the possibility to draw comparisons between the estimates for different countries.[80]

Table 6.6 VEC Analysis - European Union

Country	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
Austria	1	-513.974	22.8	0.07
	2	-999.042 *		
	3	-1,444.040 **		
	4	-206.915		
	5	-1,150.761 *		
	6	-2,121.334 ***		
	7	-447.014		
Belgium	1	-113.443	23.0	< 0.01
	2	-3,709.419 ***		
	3	-1,818.669 *		
	4	-816.405		
	5	-1,755.368 *		
	6	-1,910.333 *		
	7	-1,356.804		
Bulgaria	1	-273.561	12.4	0.68
	2	-420.612		
	3	-1,180.800		
	4	-139.811		
	5	-450.425		
	6	-656.133		
Czech Republic	1	-1,479.738 **	38.4	0.01
Denmark	1	-7.409 *	17.1	0.11
Estonia	1	-295.370 *	54.0	0.65
Finland	1	-346.208	9.2	0.00
France	1	-273.170	16.9	0.80
	2	-1,310.668 *		
	3	-177.920		
	4	-1,238.966		
	5	-734.960		
Germany	1	-808.914	12.8	0.20
Hungary	1	-54.622	7.9	0.07
	2	-33.745		
	3	-169.069 *		
	4	-83.122		

VEC Analysis - European Union (continued)				
Country	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
Ireland	1	154.553	4.5	0.85
Italy	1	-1,779.317 *	21.9	0.05
	2	-1,427.685		
	3	-1,613.490 *		
	4	-3,540.715 ***		
	5	-2,380.887 *		
	6	-2,952.837 **		
	7	-1,912.474 *		
Latvia	1	-16.070	3.6	0.33
	2	-642.809		
	3	-65.989		
	4	-357.254		
Lithuania	1	-38.252 **	5.3	0.50
Luxembourg	1	-830.361 *	16.3	0.67
	2	-1,076.678 *		
	3	-25.689		
	4	-301.482		
	5	-507.856		
Netherlands	1	-462.186	25.6	0.04
	2	-441.719		
Poland	1	-1,709.251 *	22.9	0.26
	2	-2,402.533 **		
	3	-767.379		
Portugal	1	-63.326	20.1	0.17
	2	-68.925		
	3	-16.280		
Romania	1	579.121	13.4	0.40
Slovakia	1	-46.107	8.5	0.35
	2	-44.205		
	3	-20.331		
Spain	1	-1,693.335 *	12.5	< 0.10
	2	-701.235		
	3	-180.341		
Sweden	1	-895.626 *	23.5	0.26
	2	-198.898		
	3	-513.958		
	4	-84.600		
United Kingdom	1	64.888	9.4	0.39

Source:
Author's calculations (EViews®)

* statistically significant at 68% error bands
** statistically significant at 90% error bands
*** statistically significant at 95% error bands

6.2.1.1 Austria

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to a decline of Austrian steel exports to the U.S. which lasts for seven months. The impulse response peak is reached six months after the shock at -2,121qmt. The impulse response values for periods two (= 2nd month after the shock) (68% error bands), three (90% error bands), five (68% error bands), and six (95% error bands) are statistically significant.

Variance Decomposition Analysis

Fifteen months after the shock the oil price variable accounts for 22.8% of the volatility in the steel export variable. This indicates that the relative importance of the oil price variable for the steel export variable is high.

Granger Causality Analysis

There is Granger causality at the 10% level. The GC test result confirms the statistical usefulness or the predictive value of the oil price variable for the steel export variable.

Trade Distance Analysis

Austria produces coking coal domestically (2008: 1,554tst) and may also import coking coal from neighbouring net exporter Czech Republic[81] if necessary. Therefore, upstream trade costs and trade distances for coking coal imports are expected to be comparatively moderate. Austria is a net importer of iron ore with net imports of 5,017tmt in 2008.

Because Austria is landlocked, no direct maritime trade distances can be calculated. The trade distance calculated for neighbouring Italy shows that iron ore imports from the largest exporting countries (Australia, Brazil) involve very long upstream trade distances. This also accounts for downstream steel export trade distances to the United States. These distances may pose a significant trade barrier at high oil prices. The burden of being landlocked is another trade barrier for Austria.

Competitiveness Analysis

Austria is an industrialised country placed 14th in the GCI of 2008/2009. The country consists of a highly developed overall infrastructure (rank 6) and is quite competitive in terms of domestic market size (rank 34) and foreign market size (rank 37) by international standards.

Austrian manufacturing wages are slightly below U.S. wages ($20.86 vs. $21.50). Hourly compensation costs are not available for the fabricated product manufacturing sector. Austria is not competitive in terms of hourly compensation costs in the primary metal manufacturing sector when compared to the U.S. ($49.57 vs. $31.82). Therefore, there are no wage or compensation cost benefits that could balance long-distance trade costs for steel exports to the United States.

Conclusion

The largely statistically significant seven-month decrease of Austrian steel exports to the U.S. due to a shock in the oil price variable may be driven by long upstream and downstream trade distances. The fact that the country is landlocked and has a comparative disadvantage against the U.S. in terms of labour costs may also play a role.

6.2.1.2 Belgium

Impulse Response Analysis

A shock to oil prices leads to a negative response of Belgian steel exports to the U.S. which lasts for seven months. The impulse response peak is reached two months after the shock at -3,709qmt. The impulse response values for periods two (95% error bands), three, five and six (68% error bands) are statistically significant.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable contributes about 23% of the volatility in the steel export variable. Therefore, the relative importance of the oil price variable for the steel export variable is high.

Granger Causality Analysis

There is Granger causality at the 1% level. The GC test result confirms the statistical usefulness or the predictive value of the oil price variable for the steel export variable.

Trade Distance Analysis

Belgium produces coking coal domestically (2008: 2,545tst) but is a net importer of iron ore (2008: 12,636tmt).[82]

Importing iron ore from one of the main exporting countries involves long/very long trade distances (Australia: 18,131km; Brazil: 9,647km). Trade distances for coking coal imports in addition to domestic production would also be long or very long (Australia: 22,452km; U.S. East Coast: 6,797km[83]). Finally, steel downstream trade distances to the U.S. are also long by international standards (U.S. East Coast: 6,424km). These distances pose a burden for upstream/downstream trade at high oil price levels.

Competitiveness Analysis

Belgium is an industrialised country placed 19th in the GCI of 2008/2009. The country profits from a well-developed overall infrastructure (rank 15) and an excellent port infrastructure (rank 7). Moreover, Belgium is in the top thirty in terms of domestic (rank 28) and foreign market size (rank 29) which might help to generate economies of scale if the Belgian steel industry is not too fragmented.

Belgian manufacturing wages are slightly above U.S. wages ($22.88 vs. $21.50). Belgium is not competitive with the U.S. in terms of hourly compensation costs in the primary metal manufacturing ($46.97 vs. $31.82) and the fabricated product manufacturing ($26.15 vs. $37.82) sectors. Therefore, Belgium has a comparative labour cost disadvatage in relation to the United States.

Conclusion

The largely statistically significant seven-month decrease of Belgian steel exports to the U.S. following a one standard deviation oil price shock may be driven by long upstream and downstream trade distances for iron ore imports and steel exports. The decline in steel exports may be fostered by a comparative disadvantage in labour costs in relation to the United States. Obviously, Belgium's well-developed infrastructure cannot outbalance the impact of the oil price shock. Additionally, Belgian steel exports to the U.S. are analysed per steel export category in section 6.4.2.1.

6.2.1.3 Bulgaria

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to a decline of Bulgarian steel exports to the U.S. which lasts for six months. The impulse response peak is reached three months after the shock at -1,181qmt. The impulse responses are statistically insignificant.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 12.4% of the volatility in the steel export variable. That is, the relative importance of the oil price variable for the steel export variable is moderate.

Granger Causality Analysis

There is no Granger causality at the 1%, 5% or 10% level.

Trade Distance Analysis

Bulgaria produces coking coal domestically. However, production volumes seem to decrease over time (production volumes in 2005: 819tst; 2006: 737tst; 2007: 578tst; 2008: 369tst). Bulgaria imports considerable quantities of iron ore (2008: 526tmt).

Importing iron ore from the main exporting countries involves very long upstream trade distances (Australia: 13,768km; Brazil: 11,362km). In case of coking coal imports in addition to domestic production, trade distances would also be very long (Australia: 18,088km; U.S. East Coast: 10,216km). Finally, steel downstream trade distances to the U.S. are also long (U.S. East Coast: 9,843km). Long-distance trade poses a burden for upstream/downstream trade at high oil prices.

Competitiveness Analysis

Bulgaria is an industrialising country placed on position 76 in the GCI of 2008/2009. The Bulgarian infrastructure (overall infrastructure: rank 109; port infrastructure: rank 79) is underdeveloped by European and international standards. In terms of market size, Bulgaria is ranked on positions 60 (domestic market size), and 59 (foreign market size).

No data are available on Bulgarian manufacturing wages and compensation costs. However, it can be assumed that Bulgarian labour costs are lower in relation to the U.S. because labour costs in industrialising countries are by tendency below labour costs in industrialised countries. The labour cost advantage should balance long-distance transport costs to a certain extent but is likely to shrink with rising oil prices.

Conclusion

The six-month long decrease of Bulgarian steel exports to the U.S. resulting from a one-standard deviation oil price shock may be driven by long-trade distances, underdeveloped infrastructure, and low market size. The composition of steel exports may also play a role. Industrialising countries tend to export low-value steel products. For those products, the relative share of transport costs to final selling prices is higher than for high-value products exported form industrialised countries. Low labour costs might contribute to the statistical insignificance of the decline of steel exports to the United States.

6.2.1.4 Czech Republic

Impulse Response Analysis

A positive oil price shock leads to a one-month decline of Czech steel exports to the United States. The decline (-1,480qmt) is statistically significant at 90% error bands.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 38.4% of the volatility in the steel export variable. Therefore, the relative importance of the oil price variable for the steel export variable is very high.

Granger Causality Analysis

There is Granger causality at the 5% level (and almost at the 1% level; p-value: 0.0115). The GC test result confirms the statistical usefulness or the predictive value of the oil price variable for the steel export variable.

Trade Distance Analysis

The Czech Republic is one of the main coking coal exporters (2010: 4Mt). On the other hand, the country imports significant quantities of iron ore (2008: 6,800tmt).

Because the Czech Republic is landlocked, no direct maritime trade distances can be calculated. As a result of the country's geographic location, iron ore imports from overseas and steel exports to the U.S. involve considerable overland transport in addition to the long maritime trade distances involved.

Competitiveness Analysis

The Czech Republic is an industrialised country ranked 33rd in the GCI of 2008/2009. The Czech infrastructure rankings (overall infrastructure: rank 51; port infrastructure: rank 61) are average by international standards. The country's foreign market size (rank 26) is somewhat larger than its domestic market size (rank 40) which may result from regional trade within the EU.

Czech manufacturing wages ($5.88 vs. $21.50) and compensation costs (primary metal manufacturing: $11.21 vs. $31.82; fabricated product manufacturing: $9.44 vs. $26.15) are notably lower when compared to the United States. The large gap in labour costs might partially balance the overland and maritime transport costs involved in the steel industry's upstream and downstream trade. However, the labour cost advantage may be counterbalanced to some extent or even reversed by rising fuel costs for overland and maritime transport.

Conclusion

The downturn in Czech steel exports to the U.S. is short but statistically significant. One reason for the rather short downturn in export levels to the U.S. may be low labour costs.

The disadvantage of iron ore imports involving overland transport and possibly long-distance maritime transport may be counterbalanced by coking coal abundance.

6.2.1.5 Denmark

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to a decline of Danish steel exports to the U.S. which lasts for one month. The decline (-7qmt) is statistically significant at 68% error bands.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 17% of the volatility in the steel export variable. This indicates that the relative importance of the oil price variable for the steel export variable is moderate.

Granger Causality Analysis

The p-value (0.106) for the Granger causality test is nearly significant at the 10% level.

Trade Distance Analysis

Denmark has no domestic coking coal production. Therefore, the coking coal required for steel production needs to be imported. Denmark is also a net importer of iron ore (2008: 99tmt).

Importing coking coal (Australia: 23,285km; U.S. East Coast: 7,191km) and iron ore (Australia: 18,964km; Brazil: 10,480km) from one of the main exporting countries involves long and/or very long upstream trade distances. In addition, exporting steel to the U.S. East Coast involves a long trade distance of 6,820km.

Competitiveness Analysis

The industrialised country's performance in the GCI of 2008/2009 (rank 3) is excellent despite its moderate market size (domestic market: rank 46; foreign markets: rank 44). Amongst other things, the Danish economy profits from an excellent overall (rank 7) and port infrastructure (rank 5).

Manufacturing wages in Denmark are significantly higher compared to U.S. wages ($32.56 vs. $21.50). Hourly compensation cost data are not available for Denmark but it can be assumed that compensation cost levels are also above U.S. standards due to the highly developed Danish welfare system.

Conclusion

The reduction of Danish steel exports to the U.S. is short but statistically significant. On the one hand, the shortness of the downturn may be due to Denmark's excellent infrastructure. Moreover, Denmark possibly has many high-value/high-quality steel products in its export portfolio which are less affected by increasing transport costs than low-value/low-quality products.

On the other hand, several factors contribute to the statistical significance of the downturn. The main factors considered in the analysis are market size, which possibly limits the generation of economies of scale, high upstream and downstream transport costs, and a comparative disadvantage in labour costs relative to the United States.

6.2.1.6 Estonia

Impulse Response Analysis

A one-standard deviation shock in the real oil price leads to a decline of Estonia's steel exports to the U.S. that lasts for one month. The decline (-295qmt) is statistically significant at 68% error bands.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 54% of the volatility in the steel export variable. That is, the relative importance of the oil price variable for the steel export variable is very high.

Granger Causality Analysis

There is no Granger causality at the 1%, 5% or 10% level.

Trade Distance Analysis

Estonia produces coking coal domestically (2008: 38tmt) and may additionally import coking coal from neighbouring Russia if necessary. No data are available for Estonian iron ore production, imports or exports. In case Estonia would have to import from one of the largest exporting countries, this would involve very long trade distances (Australia: 19,816km; Brazil: 11,334km). However, neighbouring Russia is also a significant net exporter of iron ore. Finally, exporting steel products to the U.S. East Coast (7,819km) involves long-distance trade.

Competitiveness Analysis

Estonia, which is in the transition phase from an industrialising to an industrialised country, has been ranked on position 32 in the GCI of 2008/2009. Estonia has a solid overall infrastructure (rank 37) and a good port infrastructure (rank 20). On the other hand, the Baltic country has a considerable disadvantage due to its small domestic (rank 93) and foreign (rank 77) market size.

Estonia has a comparative advantage in manufacturing wages over the U.S. ($5.66 vs. $21.50). No data are available for Estonian compensation costs, but it can be assumed that compensation costs are also considerably lower than in the United States.

Conclusion

The decline in Estonia's steel exports to the U.S. is short but statistically significant. In terms of factor endowments, coking coal and iron ore are either produced domestically or can be imported from neighbouring Russia. Therefore, Estonia may have an advantage regarding upstream trade costs when compared with many other EU members. Wage differences between Estonia and the U.S. may also help to balance increasing downstream transport costs.

Apart from rising transport costs, the small market size may be one factor contributing to the short but significant downturn of steel exports to the United States.

6.2.1.7 Finland

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to a decline of Finnish steel exports to the U.S. that lasts for one month. The decline (-346qmt) is statistically insignificant.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts 9.2% of the volatility in the steel export variable. This indicates that the explanatory power of the oil price variable for the steel export variable is rather low.

Granger Causality Analysis

There is Granger causality at the 1% level. This indicates the statistical usefulness or the predictive value of the oil price variable for the steel export variable.

Trade Distance Analysis

Finland produces coking coal domestically (2008: 947tst) and is a net importer of iron ore (2008: 3,121tmt).

Importing iron ore from one of the main exporting countries involves very long upstream trade distances (Australia: 19,824km; Brazil: 11,342km). In case of coking coal imports in addition to domestic production, trade distances would also be long or very long (Australia:

24,146km; U.S. East Coast: 8,199km). Finally, downstream trade distances for steel to the U.S. are also long (U.S. East Coast: 7,862km). Long trade distances pose a burden for upstream/downstream trade at high oil price levels.

Competitiveness Analysis

Finland is in the top ten of the GCI of 2008/2009 (rank 6) despite its moderate market size (domestic market: rank 50; foreign markets: rank 47). Amongst other things, the Finnish economy profits from an excellent overall infrastructure (rank 5) and port infrastructure (rank 6).

Manufacturing wages in Finland are slightly higher than U.S. wages ($23.07 vs. $21.50). For hourly compensation costs, the difference is more distinctive (primary metal manufacturing: $44.30 vs. $31.82; fabricated product manufacturing: $34.17 vs. $26.15).

Conclusion

The decline of Finland's steel exports to the U.S. as a result of a one-standard deviation oil price shock is short and statistically insignificant. The Scandinavian country's excellent infrastructure is certainly helpful for absorbing the impact of increasing maritime transport costs. On the other hand, Finland's small market size and the relatively high compensation costs might impact the competitiveness of its steel industry. It is likely that the steel industry predominantly produces high-value/high-quality steel products which are less vulnerable to rising transport costs which is often the case in industrialised economies. This would then contribute to the steel industry's ability to cope with an oil price shock.

6.2.1.8 France

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to a decline of French steel exports to the U.S. which lasts for five months. The impulse response peak is reached two months after the shock at -1,311qmt. The peak impulse value is statistically significant at 68% error bands.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 16.9% of the volatility in the steel export variable. This indicates a moderate relative importance of the oil price variable for the steel export variable.

Granger Causality Analysis

There is no Granger causality at the 1%, 5% or 10% level.

Trade Distance Analysis

France produces coking coal domestically (2008: 4,947tst) and is a net importer of iron ore (2008: 18,232tmt).

Importing iron ore from the main exporting countries involves long/very long upstream trade distances (Australia: 15,020km; Brazil: 8,978km). In case of coking coal imports in addition to domestic production, trade distances would also be long/very long (Australia: 19,340km; U.S. East Coast: 7,830km). Finally, steel downstream trade distances to the U.S. are also long (U.S. East Coast: 7,460km). These distances pose a burden for upstream/downstream trade at high oil price levels.

Competitiveness Analysis

France is an industrialised country placed 16th in the GCI of 2008/2009. The country has been ranked in the top ten in terms of overall infrastructure (rank 4), port infrastructure (rank 10), domestic market size (rank 7), and foreign market size (rank 10).

French manufacturing wages are slightly lower than U.S. manufacturing wages ($20.30 vs. $21.50). Hourly compensation costs in the French fabricated product manufacturing sector are higher when compared with the U.S. ($33.26 vs. $26.15). In the primary metal manufacturing sector the difference to the U.S. is even more pronounced ($42.31 vs. $ 31.82).

Conclusion

The five-month decrease of French steel exports to the U.S. is partially statistically significant. The impact of trade distance costs in relation to high oil prices may be partially balanced by France’s excellent overall and port infrastructure and its considerable market size. On the other hand, the comparative disadvantage in terms of labour costs in relation to the U.S. has a negative influence on the competitiveness of the French steel industry in relation to the U.S. steel industry. Additionally, French steel exports to the U.S. are analysed per steel export category in section 6.4.2.2.

6.2.1.9 Germany

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to a decline of German steel exports to the U.S. that lasts for one month. The decline (-809qmt) is statistically insignificant.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 12.8% of the volatility in the steel export variable which indicates that the relative importance of the oil price variable for the steel export variable is moderate.

Granger Causality Analysis

There is no Granger causality at the 1%, 5% or 10% level.

Trade Distance Analysis

Although Germany produces coking coal domestically (2008: 9,085tst), it is one of the most significant coking coal importers worldwide (2008: 9Mt). Germany is also one of the largest net importers of iron ore (2008: 44,305tmt).

Therefore, Germany faces considerable upstream trade distance costs for coking coal (Australia: 22,954km; U.S. East Coast: 7,145km) and iron ore imports (Australia: 18,633km; Brazil: 10,149km) from the largest exporting countries. Long downstream trade distances for steel exports to the U.S. (East Coast: 6,775km) are also significant.

Competitiveness Analysis

Germany is an industrialised country placed 7th in the GCI of 2008/2009. The country is among the top five in the rankings for overall infrastructure (rank 3), port infrastructure (rank 4), domestic market size (rank 5), and foreign market size (rank 3).

Germany has a moderate comparative disadvantage against the U.S. with regard to manufacturing wages ($25.05 vs. $21.50) and a considerable comparative disadvantage when it comes to compensation costs (primary metal manufacturing: $55.09 vs. $31.82; fabricated product manufacturing: $41.17 vs. $26.15).

Conclusion

German steel exports to the U.S. decrease for one month as the result of an oil price shock. The short decrease is statistically insignificant. It seems that the German steel industry is able to absorb the impact of high ocean transport costs due to high oil price levels quite well despite its high labour costs. The resilience against rising transport costs may, amongst other things, be due to Germany's excellent overall infrastructure and port infrastructure and its large market size. Additionally, German steel exports to the U.S. are analysed per steel export category in section 6.4.2.3.

6.2.1.10 Hungary

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to a decline of Hungarian steel exports to the U.S. which lasts for four months. The impulse response peak is reached three months after the shock at -169qmt. The impulse response value for the peak-period is statistically significant at 68% error bands.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 7.9% of the volatility in the steel export variable which indicates that the relative importance of the oil price variable for the steel export variable is rather low.

Granger Causality Analysis

There is Granger causality at the 10% level. The GC test result confirms the statistical usefulness or the predictive value of the oil price variable for the steel export variable.

Trade Distance Analysis

Hungary produces coking coal domestically (2008: 1,101tst) and is an iron ore net importer (2008: 1,900tmt).

Because Hungary is landlocked, no direct maritime trade distances can be calculated. In case iron ore would be imported from one of the two largest iron ore exporters, Australia and Brazil, the imports would involve significant maritime and overland transport costs. This also accounts for downstream steel export trade distances to the United States. The trade distances (including maritime and overland transport) pose a burden for upstream/downstream trade at high oil price levels.

Competitiveness Analysis

Hungary is in the transition phase of becoming an industrialised country. It is placed 62nd in the GCI of 2008/2009. The country's overall infrastructure is underdeveloped (rank 70) and its market size (domestic: rank 49; foreign: rank 33) is moderate.

Hungary's manufacturing wages are well below U.S. wages ($4.71 vs. $21.50). The same applies for hourly compensation costs (primary metal manufacturing: $11.68 vs. $31.82; fabricated product manufacturing: $6.98 vs. $26.15).

Conclusion

The partially statistically significant decline of steel exports from Hungary to the U.S. resulting from a one-standard deviation oil price shock may be limited by low labour costs.

On the other hand, the country is landlocked, has a comparatively weak infrastructure and a relatively small market size. These factors might contribute to the downturn.

6.2.1.11 Ireland

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to an increase of Irish steel exports to the U.S. that lasts for one month. The increase (155qmt) is statistically insignificant.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 4.5% of the volatility in the steel export variable. This means that the relative importance of the oil price variable for the steel export variable is very low.

Granger Causality Analysis

There is no Granger causality at the 1%, 5% or 10% level.

Trade Distance Analysis

Ireland does not produce coking coal domestically. Therefore, the coking coal used in the steel production process needs to be imported from overseas. Due to insufficient data availability it is unclear whether Ireland is a net importer or exporter of iron ore.

Ireland faces considerable upstream trade distance costs for coking coal imports (Australia: 22,155km; U.S. East Coast: 6,102km) and potentially considerable trade distance costs for iron ore (Australia: 17,835km; Brazil: 9,334km) if the raw materials are imported from the most significant exporters. The downstream trade distance costs to the U.S. are also considerable (East Coast: 5,730km). However, the trade distance for Irish steel exports to the U.S. is among the lowest for EU member countries. Only for Portugal, the distance of trade is marginally lower (5,672km).

Competitiveness Analysis

Ireland is an industrialised country placed 22nd in the GCI of 2008/2009. The country is ranked average in terms of overall infrastructure (rank 64), port infrastructure (rank 64), domestic market size (rank 51), and above average in foreign market size (rank 35).

Ireland has a moderate competitive disadvantage against the U.S. with regard to manufacturing wages ($24.76 vs. $21.50) and compensation costs (primary metal manufacturing: $32.75 vs. $31.82; fabricated product manufacturing: $28.59 vs. $26.15).

Hence, there are no labour cost benefits that could balance the cost disadvantage of transport costs compared to the U.S. steel industry.

Conclusion

The ability of the Irish steel industry to absorb the impact of rising transport costs due to increasing oil prices despite average competitiveness in terms of infrastructure and market size and despite slightly higher labour costs compared to the U.S. is quite remarkable. Steel exports to the U.S. even increase slightly although the increase is short and statistically insignificant.

The downstream distance of trade for Ireland is lower than for most other EU members. However, this difference stops short of explaining the resilience of the Irish steel industry against rising oil prices. The Irish steel industry's performance could possibly be due to other softer factors. For example, Ireland and the U.S are both Anglophone nations and cultural affiliation (common Anglo-Saxon culture) may also play a role.

6.2.1.12 Italy

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to a decline of Italian steel exports to the U.S. which lasts for seven months. The maximum decrease occurs four months after the shock at -3,541qmt. The impulse response values for periods one, three (both at 68% error bands), four (95% error bands), five (68% error bands), six (90% error bands) and seven (68% error bands) are statistically significant.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable contributes 21.9% of the volatility in the steel export variable. Therefore, the relative importance of the oil price variable for the steel export variable is high.

Granger Causality Analysis

There is Granger causality at the 5% level. The GC test result confirms the statistical usefulness or the predictive value of the oil price variable for the steel export variable.

Trade Distance Analysis

Although Italy produces coking coal domestically (2008: 4,943tst), it is one of the most significant importers of coking coal (2011: 5.6Mt). Moreover, Italy is one of the largest net importers of iron ore (2008: 16,313tmt).

Therefore, the Italian steel industry faces considerable upstream trade distance costs for coking coal (Australia: 19,079km; U.S. East Coast: 8,149km) and iron ore imports (Australia: 14,759km; Brazil: 9,297km). Downstream trade distance costs for steel exports to the U.S. (East Coast: 7,776km) are also significant.

Competitiveness Analysis

Italy is an industrialised country placed 49th in the GCI of 2008/2009. The country is ranked in the top twenty in terms of domestic (rank 10) and foreign market size (rank 13). However, for an industrialised country, Italy's infrastructure (overall infrastructure: rank 73; port infrastructure: rank 95) is dramatically underdeveloped.

Italy has a solid comparative advantage against the U.S. with regard to manufacturing wages ($17.80 vs. $21.50), is competitive in terms of compensation costs in the primary metal manufacturing sector ($33.17 vs. $31.82), and has a moderate comparative disadvantage regarding compensation costs in the fabricated product manufacturing sector ($31.63 vs. $26.15).

Conclusion

The statistically significant seven-month decrease of Italian steel exports to the U.S. following a one-standard deviation oil price shock may be driven by long upstream and downstream trade distances. In addition, Italy's infrastructure is underdeveloped and may further accelerate the vulnerability of its steel industry to rising oil prices.

It seems that Italy's relatively large market size cannot balance the above-mentioned negative factors. The country's wage and compensation cost structure in the manufacturing sector also seems to fall short to contribute decisively to the competitiveness of its steel industry. Additionally, Italian steel exports to the U.S. are analysed per steel export category in section 6.4.2.4.

6.2.1.13 Latvia

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to a four-month long decline of Latvian steel exports to the United States. The impulse response peak is reached two months after the shock at -643qmt. The impulse response values are statistically insignificant.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 3.7% of the volatility in the steel export variable. In other words, the relative importance of the oil price variable for the steel export variable is very low.

Granger Causality Analysis

There is no Granger causality at the 1%, 5% or 10% level.

Trade Distance Analysis

Latvia does not produce coking coal domestically. Coking coal imports may come from neighbouring Poland and/or nearby Russia which are both major exporters. Imports from the largest exporting countries, however, involve long/very long trade distances (Australia: 24,032km; U.S. East Coast: 8,084km). Due to a lack of data, it is not clear whether the Latvian steel industry depends on iron ore imports. If iron ore is not imported from nearby net exporters Sweden and/or Russia but from one of the main exporting countries, imports involve very long trade distances (Australia: 19,711km; Brazil: 11,227km). The trade distance exemplarily calculated for Latvian steel exports to the U.S. East Coast is also long (7,711km).

Competitiveness Analysis

Latvia is in the transition phase from an industrialising country to an industrialised country and is placed 54th in the GCI of 2008/2009. The country is ranked average in terms of overall (rank 59) and port infrastructure (rank 52). Latvia's market size (domestic market size: rank 79; foreign market size: rank 80) is below average by international standards.

No data are available for Latvian manufacturing wages and hourly compensation costs. However, it can be assumed that labour costs are similar to nearby Estonia which is in the same development phase. If so, the Latvian steel industry would profit from considerably lower labour costs in relation to the U.S. steel industry.

Conclusion

Latvia's statistically insignificant decrease in steel exports to the U.S. resulting from a one-standard deviation shock may amongst other things be fostered by a lack of market size. Should labour costs be below U.S. standards as can be expected, this could somewhat dampen the impact of rising oil prices. This also accounts for close raw material sourcing from Sweden or Russia which might contribute to the statistical insignificance of the downturn in steel exports to the United States.

6.2.1.14 Lithuania

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to a reduction of Lithuanian steel exports to the U.S. that lasts for one month. The decrease (-38qmt) is statistically significant.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 5.3% of the volatility in the steel export variable. Therefore, the relative importance of the oil price variable for the steel export variable is rather low.

Granger Causality Analysis

There is no Granger causality at the 1%, 5% or 10% level.

Trade Distance Analysis

Lithuania does not produce coking coal domestically. Coking coal imports may come from neighbouring Poland and/or Russia which are both major exporting countries. Imports from the largest exporting countries would involve long/very long trade distances (Australia: 23,719km; U.S. East Coast: 7,790km). Due to a lack of data, it is not clear whether Lithuania depends on iron ore imports. If iron ore would not be imported from nearby net exporters Sweden and/or Russia but from one of the two largest exporting countries, very long trade distances would be involved (Australia: 19,398km; Brazil: 10,916km). The trade distance estimated for Lithuanian steel exports to the U.S. East Coast is long (7,419km).

Competitiveness Analysis

Lithuania is in the transition phase from an industrialising country to an industrialised country and is placed 44th in the GCI of 2008/2009. The performance of the country's infrastructure (overall infrastructure: rank 47; port infrastructure: rank 43) is average by international standards. Its market size (domestic: rank 70; foreign: rank 69) is below average.

No data are available for Lithuanian manufacturing wages and hourly compensation costs. However, it can be assumed that labour costs are similar to nearby Estonia which is in the same development phase. If so, the Lithuanian steel industry would have the comparative advantage of considerably lower labour costs in comparison with the U.S. steel industry.

Conclusion

The decline of Lithuanian steel exports to the U.S. is short but statistically significant. In terms of factor endowments, coking coal and iron ore may be imported from neighbouring

Russia or nearby Sweden. Therefore, Lithuania may have an advantage regarding upstream trade costs. Wage differences between Estonia and the U.S. may also help to balance increasing downstream transport costs.

In the case of Lithuania, in addition to rising oil prices, relatively small market size may be one factor contributing to the short but statistically significant downturn of steel exports to the United States.

6.2.1.15 Luxembourg

Impulse Response Analysis

A positive one-standard deviation oil price shock leads to a reduction of Luxembourg's steel exports to the U.S. which lasts for five months. The impulse response peak is reached two months after the shock at -1,077qmt. The impulse response values for periods one and two are statistically significant at 68% error bands.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 16.3% of the volatility in the steel export variable. This indicates that the relative importance of the oil price variable for the steel export variable is moderate.

Granger Causality Analysis

There is no Granger causality at the 1%, 5% or 10% level.

Trade Distance Analysis

Luxembourg does not produce coking coal domestically. Therefore, the coking coal used in the steelmaking process needs to be imported. Figures on iron ore imports are only available for Belgium and Luxembourg combined (2008: 12,636tmt). Despite the fact that the vast majority of combined imports are consumed by Belgium, Luxembourg can also be considered as a net importer of iron ore.

Luxembourg is landlocked. Therefore, no maritime trade distances can be estimated. Presumably, most coking coal and iron ore imports of Luxembourg shipped by sea arrive at the port of Antwerp, Belgium. Steel exports from Luxembourg to the U.S. are also likely to be shipped from Antwerp to a large extent. In addition to the significant ocean transport costs for Luxembourg's trade at high oil prices, the burden of being landlocked (which involves overland shipments) poses another trade barrier for the country.

Competitiveness Analysis

Luxembourg is an industrialised country placed 25th in the GCI of 2008/2009. The country's overall infrastructure (rank 14) is well developed. With regard to port infrastructure, Luxembourg is likely to profit from its proximity to the highly efficient ports of Antwerp and Rotterdam. However, Luxembourg faces disadvantages in terms of economies of scale due to its small domestic (rank 97) and average foreign (rank 56) market size.

For Luxembourg, no data are available on wages and compensation costs. However, it can be assumed that industrialised Luxembourg has no significant advantage in labour costs when compared to the United States.

Conclusion

The partially statistically significant five-month decrease of Luxembourg's steel exports to the U.S. following a one-standard deviation oil price shock may be driven by long upstream and downstream trade distances which involve overland transport. Moreover, the fact that the country has a disadvantage in terms of market size and possibly labour costs may also contribute to the decline of steel exports to the United States.

6.2.1.16 Netherlands

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to a decline of Dutch steel exports to the U.S. which lasts for two months. The impulse response peak is reached one month after the shock at -462qmt. The impulse response values are statistically insignificant.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 25.6% of the volatility in the steel export variable. Hence, the relative importance of the oil price variable for the steel export variable is high.

Granger Causality Analysis

There is Granger causality at the 5% level. The GC test result confirms the statistical usefulness or the predictive value of the oil price variable for the steel export variable.

Trade Distance Analysis

The Netherlands produce coking coal domestically (2008: 2,299tst) and are a net importer of iron ore (2008: 7,889tmt).

Importing iron ore from one of the main exporting countries involves long/very long upstream trade distances (Australia: 18,176km; Brazil: 9,692km). In case of coking coal imports in addition to domestic production trade distances would also be long/very long (Australia: 22,496km; U.S. East Coast: 6,841km). Steel downstream trade distances to the U.S. are also long (U.S. East Coast: 6,469km). Long trade distances pose a burden for upstream/downstream trade at high oil price levels.

Competitiveness Analysis

The Netherlands are an industrialised country placed 8th in the GCI of 2008/2009. The country is ranked in the top twenty in terms of infrastructure (overall infrastructure: rank 17; port infrastructure: rank 3) and market size (domestic: rank 20; foreign: rank 14). The excellent port infrastructure may be a significant advantage for Dutch oversea steel exports. Dutch manufacturing wages are slightly above U.S. wages ($22.65 vs. $21.50). No data are available for hourly compensation costs.

Conclusion

The statistically insignificant two-month decrease of Dutch steel exports to the U.S. as a result of a one-standard deviation oil price shock may be driven by significant upstream and downstream trade distances. Thereby, the decrease remains statistically insignificant so that the impact on steel export figures remains limited. Some reasons for the insignificant estimate may be the Netherlands' overall competitiveness and its excellent port infrastructure. Additionally, Dutch steel exports to the U.S. are analysed per steel export category in section 6.4.2.5.

6.2.1.17 Poland

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to a decline of Polish steel exports to the U.S. which lasts for three months. The impulse response peak is reached two months after the shock at -2,403qmt. The impulse values for periods one (68% error bands) and two (90% error bands) are statistically significant.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 22.9% of the volatility in the steel export variable which indicates that the relative importance of the oil price variable for the steel export variable is high.

Granger Causality Analysis

There is no Granger causality at the 1%, 5% or 10% level.

Trade Distance Analysis

Poland is a net exporter of coking coal and does therefore not rely on imports. However, the country is a net importer of iron ore (2008: 7,775tmt). Hence, the Polish steel industry faces considerable upstream trade distance costs for iron ore (Australia: 19,320km; Brazil: 10,838km). Downstream trade distance costs for steel exports to the U.S. (East Coast: 7,325km) are also long.

Competitiveness Analysis

Poland is in the transition phase from an industrialising to an industrialised country and is placed 53rd in the GCI of 2008/2009. The country is quite competitive in terms of domestic market size (rank 19), and foreign market size (rank 22). However, Poland's overall infrastructure (rank 110) and port infrastructure (rank 119) are dramatically underdeveloped.
Poland has a very significant comparative advantage over the U.S. in wage costs ($4.49 vs. $21.50) and compensation costs (primary metal manufacturing: $10.04 vs. $31.82; fabricated product manufacturing: $7.78 vs. $26.15).

Conclusion

The largely statistically significant three-month decrease of Polish steel exports to the U.S. following a one-standard deviation oil price shock may be driven by long upstream and downstream trade distances. In addition, Poland's overall infrastructure and port infrastructure are dramatically underdeveloped and may also contribute to the vulnerability of its steel industry to rising oil prices.
Poland's relatively large market size cannot balance the above-mentioned negative factors. The labour cost advantage of the East European country may have been counterbalanced by rising international transport costs in 2007/2008.

6.2.1.18 Portugal

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to a decline of Portuguese steel exports to the U.S. which lasts for three months. The impulse response peak is reached two months after the shock at -69qmt. The impulse values are statistically insignificant.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 20.1% of the volatility in the steel export variable. This indicates that the relative importance of the oil price variable for the steel export variable is high.

Granger Causality Analysis

There is no Granger causality at the 1%, 5% or 10% level.

Trade Distance Analysis

Portugal does not produce coking coal domestically. Hence, the coking coal used for steel production needs to be imported. No data are available for Portuguese iron ore production, imports or exports.

Importing coking coal from one of the main exporting countries involves long/very long upstream trade distances (Australia: 20,466km; U.S. East Coast: 6,043km). In case of iron ore imports, trade distances would also be long/very long (Australia: 16,146km; Brazil: 7,710km). Downstream trade distances to the U.S. for steel are moderate (U.S. East Coast: 5,672km). Long trade distances pose a burden for upstream/downstream trade when oil prices are high.

Competitiveness Analysis

Portugal is an industrialised country placed 43rd in the GCI of 2008/2009. The country consists of a well-developed overall infrastructure (rank 23). Portuguese port infrastructure (rank 42) and market size (domestic: rank 39; foreign: rank 51) are rather average by international standards.

Portugal has a significant comparative advantage over the U.S. in manufacturing wage costs ($6.78 vs. $21.50). No data are available for hourly compensation costs.

Conclusion

Although Portugal's steel exports decline for three months after a one-standard deviation shock in oil prices, the decline remains statistically insignificant. One reason for the insignificance of the decline may be a comparative advantage over the U.S. in terms of labour costs.

6.2.1.19 Romania

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to an increase of Romanian steel exports to the U.S. which lasts for one month. The increase (579qmt) is statistically insignificant.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 13.4% of the volatility in the steel export variable which indicates that the relative importance of the oil price variable for the steel export variable is moderate.

Granger Causality Analysis

There is no Granger causality at the 1%, 5% or 10% level.

Trade Distance Analysis

Although coking coal is mined in Romania, production levels seem to decrease over time (2005: 2,084tst; 2006: 1,973tst; 2007: 1,815tst; 2008: 1,254tst). Moreover, Romania is a significant importer of iron ore (2008: 4,446tmt). The Romanian steel industry faces very long upstream trade distance costs for iron ore (Australia: 13,844km; Brazil: 11,440km) and possibly for coking coal (Australia: 12,675km; U.S. East Coast: 10,292km) when the steelmaking raw materials are imported from the biggest exporters. Downstream trade distances for steel exports to the U.S. are also long (East Coast: 9,919km).

Competitiveness Analysis

Romania is an industrialising country placed 68th in the GCI of 2008/2009. While the country is competitive internationally in terms of market size (domestic: rank 36; foreign: rank 53), its infrastructure is underdeveloped (overall infrastructure: rank 117; port infrastructure: rank 102).

Data for Romanian manufacturing wages and compensation costs are not available. However, labour costs are considered to be lower than U.S. labour costs. A comparative advantage in labour costs would reduce the impact of an oil price shock on Romania's steel exports to the United States.

Conclusion

Explaining the ability of Romania's steel industry to largely absorb the impact of rising international transport costs is challenging. To begin with, the increase in exports to the U.S. is short and statistically insignificant. The only parameters that potentially explain the steel industry's performance are low labour costs (the level of which is not exactly known) and to a lesser extent the country's market size. On the other hand, Romania's underdeveloped infrastructure should have an adverse effect on steel exports. Maybe other factors than those considered also have an effect.

It needs to be mentioned that, in contrast to the econometric results estimated for the vast majority of the other countries included in the analysis, the LM test results indicate that the estimates for Romania may be subject to autocorrelation in the residuals. Because serial correlation could not be eliminated by including additional lags (for most samples, autocorrelation could be removed by adding additional lags; see section 5.2.5.2), the estimates for Romania may be biased and should therefore be treated with caution.

6.2.1.20 Slovakia

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to a decline of Slovakian steel exports to the U.S. which lasts for three months. The impulse response peak is reached in the first month after the shock at -46qmt. The impulse values are statistically insignificant.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 8.5% of the volatility in the steel export variable. Therefore, the relative importance of the oil price variable for the steel export variable is low.

Granger Causality Analysis

There is no Granger causality at the 1%, 5% or 10% level.

Trade Distance Analysis

Slovakia produces coking coal domestically (2008: 1,743tst). Additional coking coal might be imported from the neighbouring net exporters Poland and Czech Republic. Slovakia is a net importer of iron ore (2007: 5,850tmt).

Because Slovakia is landlocked, no direct maritime trade distances can be calculated. If necessary, coking coal can be imported regionally. Iron ore imports may require considerable maritime and overland transport distances, thereby counterbalancing domestic and regional coking coal availability. The burden of being landlocked may have an impact on steel exports to the U.S. due to the overland trade distances involved in addition to maritime trade distances.

Competitiveness Analysis

Slovakia is in the transition phase from an industrialising country to an industrialised country and is placed 46th in the GCI of 2008/2009. The country's competitiveness in overall infrastructure (rank 65) and market size (domestic: rank 58; foreign: rank 46) is average by international standards.

Slovakia has a considerable comparative advantage over the U.S. in terms of manufacturing wages ($4.69 vs. $21.50) and hourly compensation costs (primary metal manufacturing: $14.15 vs. $31.82; fabricated product manufacturing: $7.78 vs. $26.15).

Conclusion

Following a one-standard deviation oil price shock, Slovakian steel exports decrease for three months. The statistically insignificant decline may, amongst other things, be due to the fact that the country is landlocked. Factors contributing to the statistical insignificance of the decline may be domestic and regional coking coal availability and low labour costs.

6.2.1.21 Spain

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to a decline of Spanish steel exports to the U.S. which lasts for three months. The impulse response peak is reached in the first month after the shock at -1,693qmt. The impulse response value for the first period is statistically significant at 68% error bands.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 12.5% of the volatility in the steel export variable. Therefore, the relative importance of the oil price variable for the steel export variable is moderate.

Granger Causality Analysis

There is Granger causality at the 10% level. The GC test result confirms the statistical usefulness or the predictive value of the oil price variable for the steel export variable.

Trade Distance Analysis

Spain produces coking coal domestically (2008: 2,916tst) and is a net importer of iron ore (2008: 6,329tmt).

Importing iron ore from one of the main exporting countries involves long/very long upstream trade distances (Australia: 15,114km; Brazil: 8,641km). In case of coking coal imports in addition to domestic production, trade distances would also be long/very long (Australia: 19,435km; U.S. East Coast: 7,495km). Steel downstream trade distances to the U.S. are long by international standards (U.S. East Coast: 7,122km). These trade distances pose a burden for upstream/downstream trade at high oil prices. Nonetheless, trade distances between Spain and Brazil (iron ore imports) and between Spain and the U.S. (steel exports, coking coal imports) are considerably lower when compared to many other EU members.

Competitiveness Analysis

Spain is an industrialised country placed 29th in the GCI of 2008/2009. In the market size rankings, the country is in the top twenty (domestic: rank 11; foreign: rank 19). The Spanish infrastructure is above average by international standards (overall infrastructure: rank 27; port infrastructure: rank 33).

Spain has a considerable comparative advantage over the U.S. in terms of manufacturing wages ($13.48 vs. $26.15) and a moderate advantage in terms of compensation costs in the fabricated product manufacturing sector ($22.69 vs. $26.15). For the primary metal manufacturing sector, compensation cost differences are marginal ($32.11 vs. $31.82).

Conclusion

The partially statistically significant decline of Spanish steel exports to the U.S. following a one-standard deviation oil price shock may be facilitated by long upstream and downstream trade distances. The moderate labour cost advantage of the Spanish steel industry over the U.S. steel industry may have somewhat counterbalanced the impact of the oil price shock. Additionally, Spanish steel exports to the U.S. are analysed per steel export category in section 6.4.2.6.

6.2.1.22 Sweden

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to a negative response in Swedish steel exports to the U.S. which lasts for four months. The maximum decrease is reached in the first month after the shock at -896qmt. The impulse response value for the first period is statistically significant at 68% error bands.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 23.5% of the volatility in the steel export variable. Therefore, the relative importance of the oil price variable for the steel export variable is high.

Granger Causality Analysis

There is no Granger causality at the 1%, 5% or 10% level.

Trade Distance Analysis

Sweden produces coking coal domestically (2008: 1,296 tst) and is a significant net exporter of iron ore (2008: 17,546tmt) which gives the Swedish steel industry a comparative advantage over industries located in resource-scarce countries. Downstream trade distances to the U.S. (East Coast: 6,844km) are a considerable cost factor due to maritime fuel costs.

Competitiveness Analysis

Sweden is an industrialised country placed 4th in the GCI of 2008/2009. The infrastructure of the Scandinavian country is well developed (overall infrastructure: rank 12; port infrastructure: rank 13). In terms of market size, the country's rankings are above average (domestic: rank 32; foreign: rank 28).

Sweden's wage cost ($23.80 vs. $21.50) and compensation cost levels (primary metal manufacturing: $42.04 vs. $31.82; fabricated product manufacturing: $34.19 vs. $26.15) are a significant cost factor for its steel industry.

Conclusion

Swedish steel exports to the U.S. decrease for four months as the result of an oil price shock. The decrease is partially statistically significant. The impact of trade distance costs may be partially balanced by Sweden's well developed infrastructure and the domestically available steelmaking raw materials. However, Sweden has a comparative disadvantage against the U.S. in terms of labour costs which might contribute to the decline of steel exports to the United States.

6.2.1.23 United Kingdom

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to an increase of the UK's steel exports to the U.S. which lasts for one month. The marginal increase (65qmt) is statistically insignificant.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 9.4% of the volatility in the steel export variable. Therefore, the relative importance of the oil price variable for the steel export variable is rather low.

Granger Causality Analysis

There is no Granger causality at the 1%, 5% or 10% level.

Trade Distance Analysis

The UK produces coking coal domestically (2008: 4,804tst) but is also one of the largest coking coal importers (2008: 7Mt). The UK is also a significant net importer of iron ore (2008: 15,275tmt).

Therefore, the steel industry in the UK faces considerable upstream trade distance costs for coking coal (Australia: 22,035km; U.S. East Coast: 6,156km) and iron ore imports (Australia: 17,983km; Brazil: 9,482km) if imports come from the main exporting countries. Downstream trade distances for steel exports to the U.S. (East Coast: 5,785km) are moderate.

Competitiveness Analysis

The industrialised United Kingdom is placed 12th in the GCI of 2008/2009. The UK is ranked among the top ten nations in terms of market size (domestic: rank 6; foreign: rank 8). Moreover, the UK is ranked among the top thirty nations in terms of infrastructure (overall infrastructure: rank 24; port infrastructure: rank 30).

The UK has a comparative disadvantage in labour costs when compared to the United States. However, the cost differences are not dramatic (manufacturing wages: $25.46 vs. $21.50; primary metal manufacturing compensation costs: $34.62 vs. $31.82; fabricated product manufacturing compensation costs: $31.96 vs. $26.15).

Conclusion

The ability of the UK's steel industry to absorb the impact of rising oil prices is noteworthy although the increase is short and statistically insignificant. The solid infrastructure and possibly economies of scale due to market size may play a role in the steel industry's resilience. Other soft factors such as common language[84] and cultural affiliation (common Anglo-Saxon culture) may also be taken into account.

6.2.1.24 Summary

Steel exports of EU members to the U.S. decline following a one-standard deviation shock in the oil price variable with the exception of Ireland, Romania and the UK.

In case of Romania, the estimates may be biased by autocorrelation and should therefore be viewed with caution. The question that remains is: What enables the steel industries of Ireland and the UK to absorb the oil price shock better than the other EU member countries? Two factors that distinguish both Ireland and the UK from the other countries are the soft factors common language and cultural affiliation. Another - though not decisive - factor may be that the calculated trade distances between Ireland/UK and the U.S. are shorter than for all other EU countries with the exception of Portugal. It needs to be emphasised, however, that the increase in exports for both Ireland and the UK is short and statistically insignificant.

For the twenty remaining EU member countries analysed, steel exports to the U.S. decline with varying intensity. Thereby, the trend of declining export figures holds for countries with different characteristics. The trend holds for Eurozone members and non-Eurozone members, industrialising and industrialised countries, large, mid-size and small economies, landlocked and non-landlocked countries and for countries from different geographic regions (e.g. Scandinavia, the Baltic States or the Benelux States). When the impulse response estimates are compared between countries of the same region, it turns out that the results are very similar for some countries and quite different between others.

Example 1: Baltic States

The country profiles of the Baltic States Estonia, Latvia and Lithuania are quite similar. The three countries are all in the transition phase from an industrialising country to an industrialised country. Moreover, the countries have rather small economies, none of them is landlocked, and their upstream and downstream trade distances are very similar. In terms of competitiveness, their rankings in the GCI of 2008/2009 do not differ dramatically (Estonia: rank 32; Latvia: rank 54; Lithuania: rank 44).

When the impulse response estimates for the Baltic States are compared, it turns out that the decrease of steel exports to the U.S. is short but statistically significant for Estonia and Lithuania. For Latvia, the decline is somewhat longer and statistically insignificant. All in all, the impulse response estimates do not differ dramatically.

Example 2: Benelux States

Comparing the impulse response estimates of the Benelux States Belgium and the Netherlands yields different results. As in the first example, the respective country profiles are similar. Both countries are industrialised, have mid-sized economies, are not landlocked and are facing similar upstream and downstream trade distances. In both countries, coking coal is produced domestically and both countries are net importers of iron ore. In the GCI ranking of 2008/2009, both countries are in the top twenty (Belgium: rank 19; Netherlands: rank 8) and in the rankings for the sub-criteria included in the analysis both countries perform quite similar (overall infrastructure: rank 15 (Belgium) vs. rank 17 (Netherlands); port infrastructure: rank 7 vs. rank 3; domestic market size: rank 28 vs. rank 20; foreign market size: rank 20 vs. rank 14). Finally, manufacturing wages are nearly identical ($22.88 vs. $22.65).

Nonetheless, the impulse responses for both countries are quite different. While Dutch steel exports to the U.S. only decline for two months following a one-standard deviation oil price shock, Belgian exports decline for seven months. While the impulse responses for the Netherlands are statistically insignificant, the impulse responses for Belgium are largely statistically significant.

Although the Netherlands perform better in the GCI ranking and are doing slightly better in most sub-categories considered, it is at least debatable whether those moderate differences in competitiveness can make up for the varying impulse response estimates. The identification of the factors behind the different impulse response estimates should be subject for future research.

Recapitulatory, the findings for the EU member countries are largely in line with the hypothesis that oil price shocks or rising (maritime) fuel costs lead to a regionalisation of trade flows and to a reduction of trade distances in the global steel industry. Thereby, the EU steel industry is not only affected by increasing fuel costs for steel exports but also by increasing fuel costs for upstream trade. For example, the EU is a net importer of iron ore of which 98% are used for steelmaking (net imports in 2008: 138,651tmt).

6.2.2 Other Europe

Section 6.2.2 analyses the econometric estimates for Norway (6.2.2.1) and Switzerland (6.2.2.2). Section 6.2.2.3 concludes.

Table 6.7 VEC Analysis - Other Europe

Country	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
Norway	1	-111.905	23.5	0.61
	2	-337.358		
	3	-1,112.005 ***		
	4	-96.348		
	5	-80.690		
Switzerland	1	54.624 *	22.7	0.00
	2	109.627 ***		
	3	8.563		

Source:
Author's calculations (EViews®)

* statistically significant at 68% error bands
** statistically significant at 90% error bands
*** statistically significant at 95% error bands

6.2.2.1 Norway

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to a decline of Norwegian steel exports to the U.S. which lasts for five months. The impulse response peak is reached three months after the shock at -1,112qmt. The impulse response value for period three is statistically significant at 95% error bands.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 23.5% of the volatility in the steel export variable. Therefore, the relative importance of the oil price variable for the steel export variable is high.

Granger Causality Analysis

There is no Granger causality at the 1%, 5% or 10% level.

Trade Distance Analysis

Norway does not produce coking coal domestically. Therefore, the coking coal used for steel production needs to be imported. Norway is a net exporter of iron ore (2008: 463tmt).
Importing coking coal from the main exporting countries involves long/very long trade distances (Australia: 23,437km; U.S. East Coast: 7,082km). The same applies for steel exports to the U.S. (East Coast: 6,278km).

Competitiveness Analysis

Norway is an industrialised country placed 15th in the GCI of 2008/2009. Norway's port infrastructure (rank 12) is relatively better developed than its overall infrastructure (rank 28). Its market size (domestic: rank 44, foreign: rank 42) is above average.
Data on Norwegian labour costs are only available for hourly compensation costs in the primary metal manufacturing sector where Norway's steel industry faces a comparative disadvantage ($53.57 vs. $31.82).

Conclusion

Norway's partially significant decline in steel exports to the U.S. following a one-standard deviation shock in the oil price variable may be facilitated by the long downstream trade distance between both countries. Long upstream trade distances for coking coal may in part be counterbalanced by domestic iron ore abundance. While the Norwegian steel industry may benefit from the country's good port infrastructure, this benefit may be somewhat counterbalanced by average competitiveness in overall infrastructure and market size. The decline of steel exports to the U.S. may be facilitated by the steel industry's drastic labour cost disadvantage compared to the U.S. steel industry.

6.2.2.2 Switzerland

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to an increase of Swiss steel exports to the U.S. which lasts for three months. The impulse response peak is reached two months after the shock at 110qmt. The impulse response values for periods one (68% error bands) and two (95% error bands) are statistically significant.

Variance Decomposition Analysis

Fifteen months after the shock, 22.7% of the forecast variation in steel exports to the U.S. can be attributed to innovations in oil prices. Therefore, the relative importance of the oil price variable for the steel export variable is high.

Granger Causality Analysis

There is Granger causality at the 1% level. The GC test result confirms the statistical usefulness or the predictive value of the oil price variable for the steel export variable.

Trade Distance Analysis

Switzerland does not produce coking coal domestically. Hence, the coking coal used for steelmaking needs to be imported. Data availability regarding iron ore is limited for Switzerland. No data are available for Swiss iron ore production or exports. However, data on iron ore imports (2007: 8tmt; 2008: 6tmt) indicate that Switzerland is an iron ore net exporter or that net import volumes are very low.

Because Switzerland is landlocked, no direct maritime trade distances can be calculated. Generally, being landlocked is regarded as a barrier to international trade in the literature.

If Switzerland imports coking coal from the main exporting countries, imports include long trade distances which are split into maritime and overland trade distances and involve high transport costs, especially at high oil price levels. The same applies for iron ore imports. However, iron ore import volumes are rather low. Steel exports to the U.S. involve significant overland and maritime trade distances

Competitiveness Analysis

Switzerland is an industrialised country and performs excellent in the GCI of 2008/2009 (rank 2). Moreover, Switzerland's overall infrastructure is the best worldwide (rank1).

Despite being landlocked, Switzerland is still in the top twenty with regard to port infrastructure (rank 17). The ranking for port infrastructure is probably a combination of an assessment of Swiss river ports and the proximity of highly efficient ports in neighbouring France. Switzerland's market size is above average (domestic: rank 30; foreign: rank 37).
The country has a comparative disadvantage in terms of manufacturing wages when compared to the U.S. ($28.17 vs. $21.50). No data are available for Swiss hourly compensation costs.

Conclusion

Recapitulatory, the largely statistically significant three-month increase in Swiss steel exports to the U.S. in response to a one-standard deviation shock in the oil price variable is remarkable. The increase occurs despite the fact that Switzerland is landlocked and has a disadvantage when compared to the U.S. in terms of manufacturing wages.
There are two explanatory approaches for the performance of the Swiss steel industry regarding exports to the United States. First, the industry profits from its excellent overall infrastructure in combination with Switzerland's proximity to highly efficient ports in neighbouring France. Second, the country's steel industry might profit from a specialisation on high-value/high-quality steel products which have a low relative share of transport costs to final selling prices when compared with low-value/low-quality steel products.

6.2.2.3 Summary

The impulse response estimates for the two non-EU members can be interpreted as follows: The impulse response estimate for Norway is by tendency in line with the estimates for the Scandinavian EU members. Steel exports to the U.S. decline for all Scandinavian countries following a one-standard deviation oil price shock. Thereby, the impulse response values are partially significant for Denmark, Norway and Sweden. The relative importance of the oil price variable for the steel export variables is also quite similar for Denmark (17.1%), Norway (23.5%), and Sweden (23.5%). The estimates for Finland, however, are somewhat different. The impulse response estimate is statistically insignificant and the variance decomposition estimate is significantly lower (9.2%) when compared to the estimates of the Scandinavian counterparts.
When the impulse response results for Switzerland are compared with those for neighbouring Austria, the following conclusions can be drawn: Although the profiles for both countries are similar, the impulse response estimates are quite different. While the difference between the variance decomposition estimates is marginal (Austria: 22.8%; Switzerland: 22.7%), the largely statistically significant impulse response results are contradictory.

Thereby, the neighbouring countries are both landlocked and their steel industries are confronted with similar upstream and downstream trade distances. Moreover, the economies of both countries are industrialised and mid-sized with comparable market size (domestic market size: rank 34 (Austria) vs. rank 37 (Switzerland); foreign market size: rank 37 (Austria) vs. rank 30 (Switzerland)). However, Switzerland is ahead in terms of overall competitiveness (Austria: rank 14; Switzerland: rank 2) and overall infrastructure (Austria: rank 6; Switzerland: rank 1). Although both countries have top rankings in terms of overall infrastructure, they depend on foreign seaports for exporting steel to the United States. While north Italian ports are logical candidates for Austrian steel exports due to their proximity, ports in southern France are logical candidates for Swiss exports. However, while French ports are very competitive internationally (rank 10), the contrary is true for Italian ports (rank 95). Additionally, while the French overall infrastructure used for overland transport of Swiss steel exports is very competitive (rank 4), the Italian overall infrastructure is not competitive at all (rank 73). Therefore, one reason for the contradictory estimates of both countries may be differences in the efficiency of overland transport and port infrastructure.

Finally, it would be interesting to compare the composition of Austrian and Swiss steel exports in terms of high- and low-value products which may be subject for further research.

6.2.3 C.I.S.

Section 6.2.3 analyses the econometric estimates for the C.I.S. members Kazakhstan (6.2.3.1), Russia (6.2.3.2) and Ukraine (6.2.3.3). Section 6.2.3.4 concludes.

Table 6.8 VEC Analysis - C.I.S.

Country	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
Kazakhstan	1	-1,503.452 ***	42.8	< 0.01
	2	-1,703.763 **		
	3	-881.870		
	4	-402.249		
	5	-1,754.579 **		
Russia	1	-2,465.667	15.4	0.68
	2	-8,585.345		
	3	-14,485.740 *		
	4	-8,943.456		
	5	-5,543.078		
	6	-3,001.981		
Ukraine	1	-1,251.252	22.6	0.00
	2	-5,822.882 **		

Source:
Author's calculations (EViews®)

* statistically significant at 68% error bands
** statistically significant at 90% error bands
*** statistically significant at 95% error bands

6.2.3.1 Kazakhstan

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to a decrease of Kazakhstan’s steel exports to the U.S. that lasts for five months. The impulse response peak is reached five months after the shock at -1,755qmt. The impulse response values for periods one (95% error bands), two (90% error bands) and five (90% error bands) are statistically significant.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 42.8% of the volatility in the steel export variable. Therefore, the relative importance of the oil price variable for the steel export variable is very high.

Granger Causality Analysis

There is Granger causality at the 1% level. The GC test result confirms the statistical usefulness or the predictive value of the oil price variable for the steel export variable.

Trade Distance Analysis

Kazakhstan is one of the main coking coal exporters (2011: 1Mt) and is also a net exporter of iron ore (2008: 13,264tmt).

No direct maritime trade distances can be calculated for Kazakhstan. Although the country is not entirely landlocked, access to the Caspian Sea does not provide the country with a direct ocean route to the United States. Therefore, exporting steel to the U.S. involves overland and/or river transport.

Competitiveness Analysis

Kazakhstan is in the transition phase from a developing country to an industrialising country and is placed 66th in the GCI of 2008/2009. The country's domestic (rank 54) and foreign market size (rank 49) are average by international standards. Kazakhstan's overall infrastructure (rank 71) is developed below average by international standards and its port infrastructure (rank 101) is significantly underdeveloped.

No data are available for Kazakh labour costs. However, due to the fact that Kazakhstan is a developing country, labour costs are expected to be well below U.S. standards.

Conclusion

Although Kazakhstan's steel industry profits from steelmaking raw material abundance, the country's steel exports to the U.S. decline for five months following a one-standard deviation shock in the oil price variable. The decline is largely statistically significant.

One reason for the significant decline may be the large downstream trade distance which involves overland and/or river transport. Moreover, Kazakhstan is not competitive internationally in terms of infrastructure.

The estimates for Kazakhstan may be biased by autocorrelation which could not be removed by adding additional lags and therefore need to be interpreted with caution.

6.2.3.2 Russia

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to a decrease of Russia's steel exports to the U.S. which lasts for six months. The impulse response peak is reached three months after the shock at -14,486qmt. The impulse response value for period three is statistically significant at 68% error bands.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable contributes 15.4% of the volatility in the steel export variable. Therefore, the relative importance of the oil price variable for the steel export variable is moderate.

Granger Causality Analysis

There is no Granger causality at the 1%, 5% or 10% level.

Trade Distance Analysis

Resource-rich Russia is one of the largest coking coal exporters worldwide (2008: 15Mt) and is also a significant net exporter of iron ore (2008: 12,878tmt).

Steel export trade distances between Russia and the U.S. are as follows: If steel is exported from the Russian west coast to the U.S. East Coast, the trade distance involved is 8,100km. If steel is exported from the Russian east coast to the U.S. West Coast, the distance of trade is 9,697km.

Competitiveness Analysis

Russia is in the transition phase from an industrialising country to an industrialised country and is placed 51st in the GCI of 2008/2009. The country is among the top ten countries in terms of domestic (rank 8) and foreign market size (rank 6). The quality of its overall (rank 78) and port infrastructure (rank 76) is below average.

No data are available for Russian labour costs. However, due to Russia's stage of development labour costs are expected to be below U.S. standards.

Conclusion

Although the immediate downturn of Russian steel exports to the U.S. lasts for two quarters, it is only partially statistically significant. The downturn may be due to a combination of significant downstream trade distances, high oil prices, and the underdeveloped Russian infrastructure. On the other hand, the downturn may be limited by steelmaking raw material abundance, the possibility to generate economies of scale and a labour cost advantage over the United States. Additionally, Russian steel exports to the U.S. are analysed per steel export category in section 6.4.3.1.

6.2.3.3 Ukraine

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to a decrease of Ukrainian steel exports to the U.S. which lasts for two months. The impulse response peak is reached two months after the shock at -5,823qmt. The impulse response value for period two is statistically significant at 90% error bands.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 22.6% of the volatility in the steel export variable. Therefore, the relative importance of the oil price variable for the steel export variable is high.

Granger Causality Analysis

There is Granger causality at the 1% level. The GC test result confirms the statistical usefulness or the predictive value of the oil price variable for the steel export variable.

Trade Distance Analysis

Ukraine produces coking coal domestically (2008: 21,539tst). Additional coking coal may be imported from net exporting neighbouring Russia and Poland. Moreover, the Ukraine is a net exporter of iron ore (2008: 19,919tmt). Therefore, the Ukrainian steel industry is in a favorable position with respect to steelmaking raw material abundance.
Downstream trade distance costs to the U.S. East Coast (10,141km), however, are a considerable cost factor, especially at high oil price levels.

Competitiveness Analysis

Ukraine is an industrialising country placed 72nd in the GCI of 2008/2009. While the country's domestic (rank 29) and foreign market size (rank 37) are above average, the quality of its overall (rank 86) and port infrastructure (rank 87) is below average.
No data are available for Ukrainian labour costs. However, due to the fact that Ukraine is an industrialising country, labour costs are expected to be below U.S. standards.

Conclusion

Although Ukraine's steel industry profits from steelmaking raw material abundance, the country's steel exports to the U.S. decline for two months following a one-standard deviation shock in the oil price variable. The decline is statistically significant and may be due to the very long downstream trade distance with the United States. The transport cost effect might be accelerated by underdeveloped infrastructure. The downturn in steel exports may be limited by solid market size and lower labour costs relative to the United States. Additionally, Ukrainian steel exports to the U.S. are analysed per steel export category in section 6.4.3.2.

6.2.3.4 Summary

Steel exports to the U.S. decline in the three C.I.S. countries analysed following a one-standard deviation oil price shock. Although there are differences in the length of the downturns, the impulse response estimates are at least partially statistically significant for all countries.

The common trend in the impulse responses may be due to the similar profiles of the countries. Although their economies are in different stages of development, in terms of overall competitiveness, they are ranked in the middle section or lower middle section of the GCI of 2008/2009 (Kazakhstan: rank 66; Russia: rank 51; Kazakhstan: rank 72). Moreover, the infrastructure of the countries is relatively underdeveloped and downstream trade distances are large. The downturn in all C.I.S. states analysed may be dampened by steel making raw material abundance, lower labour costs relative to the U.S., and market size.

The fact that Kazakhstan is most affected in terms of the statistical significance of the impulse estimates may be due to the country's unfavorable geographical location which does not allow for direct maritime trade. However, the estimates for Kazakhstan may be biased by autocorrelation and therefore need to be interpreted with caution.

Recapitulatory, the findings for the C.I.S. member countries are in line with the hypothesis that oil price shocks or rising (maritime) fuel costs lead to a regionalisation of trade flows and to a reduction of trade distances in the global steel industry.

6.2.4 North America

Section 6.2.4 analyses the econometric estimates for Canada (6.2.4.1), Costa Rica (6.2.4.2), the Dominican Republic (6.2.4.3), El Salvador (6.2.4.4), Guatemala (6.2.4.5), Honduras (6.2.4.6), Mexico (6.2.4.7), Panama (6.2.4.8), and Trinidad and Tobago (6.2.4.9). Section 6.2.4.10 concludes.

Table 6.9 VEC Analysis – North America

Country	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
Canada	1	8,534.431 ***	20.6	0.08
	2	2,488.029		
	3	6,254.213 *		
	4	3,350.379		
	5	315.480		
Costa Rica	1	97.911 *	22.7	0.00
Dominican Republic	1	80.916	13.8	0.00
	2	517.732 **		
	3	176.366		
El Salvador	1	61.932	18.3	0.67
	2	57.141		
	3	15.670		
	4	139.333 *		
	5	125.366		
	6	177.468 *		
	7	269.367 **		
Guatemala	1	60.020	5.3	0.11
Honduras	1	3.910	7.3	0.69
	2	3.435		
	3	12.525 *		
	4	20.328 *		
	5	11.023		
	6	2.494		
	7	0.069		
Mexico	1	2,521.610	14.5	0.53
	2	392.230		
	3	305.464		
	4	6,365.109		
	5	7,845.385 *		
	6	821.579		
	7	4,461.690		
Panama	1	5.290	14.3	0.00
	2	18.217		
Trinidad and Tobago	1	1,012.476 *	12.6	0.58
	2	1.025		

Source:
Author's calculations (EViews®)

* statistically significant at 68% error bands
** statistically significant at 90% error bands
*** statistically significant at 95% error bands

6.2.4.1 Canada

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to an increase of Canadian steel exports to the U.S. which lasts for five months. The impulse response peak is reached one month after the shock at 8,534qmt. The impulse response values for periods one (95% error bands) and three (68% error bands) are statistically significant.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 20.6% of the volatility in the steel export variable. Therefore, the relative importance of the oil price variable for the steel export variable is high.

Granger Causality Analysis

There is Granger causality at the 10% level. The GC test result confirms the statistical usefulness or the predictive value of the oil price variable for the steel export variable.

Trade Distance Analysis

Canada is among the largest coking coal (2010: 27Mt) and iron ore (2008: 18,982tmt) net exporters worldwide. Therefore, the Canadian steel industry profits from steelmaking raw material abundance.

Downstream trade distances for steel exports to the U.S. are comparatively short. Transporting steel from the Canadian west coast (Vancouver) to the U.S. West Coast (Long Beach) involves a short trade distance of 2,274km. Transporting steel from the Canadian east coast (Halifax) to the U.S. East Coast involves a very short trade distance of only 1,140km. Even steel exports from Canada's east coast to the U.S. Gulf Coast (New Orleans) only involve a moderate trade distance (4,307km). Moreover, steel can be exported overland or via the Great Lakes. The multiple transport routes/options and the comparably short trade distances from Canada to the U.S. provide a considerable advantage over most countries exporting steel to the U.S., especially at high oil prices.

Competitiveness Analysis

Canada is an industrialised country ranked 10th in the GCI of 2008/2009. Moreover, the country is in the top twenty in the rankings for overall infrastructure (rank 10), port infrastructure (rank 14), domestic market size (rank 13), and foreign market size (rank 15).

With regard to labour costs, Canada is competitive in manufacturing wages (\$22.40 vs. \$21.50), has a moderate disadvantage in compensation costs in the fabricated product manufacturing sector (\$29.59 vs. \$26.15), and a significant disadvantage in compensation costs in the primary metal manufacturing sector (\$44.71 vs. \$31.82).

Conclusion

Canada's statistically significant increase of steel exports to the U.S. following a one-standard deviation oil price shock is facilitated by steelmaking raw material abundance, short downstream trade distances, multiple transport routes/options, and a well-developed infrastructure. Moreover, Canada's common border with the U.S., its NAFTA membership, common language and cultural affiliation should further increase the competitive position of the country's steel industry when it comes to exports to the United States. Finally, Canada is competitive with the U.S. in terms of manufacturing wages and has only a marginal competitive labour cost disadvantage in the fabricated product manufacturing sector. Canada only has a labour cost disadvantage in the primary manufacturing sector. Additionally, Canadian steel exports to the U.S. are analysed per steel export category in section 6.4.4.1.

6.2.4.2 Costa Rica

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to an increase of Costa Rica's steel exports to the U.S. which lasts for one month. The impulse response value (98qmt) is statistically significant at 68% error bands.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 22.7% of the volatility in the steel export variable. Therefore, the relative importance of the oil price variable for the steel export variable is high.

Granger Causality Analysis

There is Granger causality at the 1% level. The GC test result confirms the statistical usefulness or the predictive value of the oil price variable for the steel export variable.

Trade Distance Analysis

Costa Rica does not produce coking coal domestically. Therefore, the coking coal used for steelmaking needs to be imported. No information is available for Costa Rica on iron ore production, imports or exports.

Importing coking coal from the U.S. involves short trade distances if imports from the Gulf Coast arrive on Costa Rica's east coast (2,495km). Importing iron ore from the second-

largest exporting country Brazil, however, includes long-distance trade (7,791km). Alternatively, iron ore might also be imported from the net exporters Canada and the United States. It is unlikely that steelmaking raw materials are imported from remote Australia.
Steel export trade distances to the U.S. Gulf Coast are short if exports are shipped from Costa Rica's east coast (2,466km).

Competitiveness Analysis

Costa Rica is an industrialising country ranked 59th in the GCI of 2008/2009. The country's market size (domestic: rank 77; foreign: rank 75) is below average by international standards and its overall (rank 103) and port infrastructure (rank 128) are significantly underdeveloped. No data are available about Costa Rica's manufacturing wages and hourly compensation costs. However, it is expected that labour costs are lower in industrialising Costa Rica than in the industrialised United States.

Conclusion

The statistically significant increase in Costa Rican steel exports to the U.S. following a one-standard deviation oil price shock may be a combination of short upstream and downstream trade distances and low labour costs.
In the competitiveness categories included in the analysis, Costa Rica performs below average by international standards. The low competitiveness in infrastructure and market size may prevent a more sustained increase of steel exports.

6.2.4.3 Dominican Republic

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to an increase of Dominican steel exports to the U.S. which lasts for three months. The impulse response peak is reached two months after the shock at 518qmt. The impulse response value for period two is statistically significant at 90% error bands.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 13.8% of the volatility in the steel export variable. This indicates that the relative importance of the oil price variable for the steel export variable is moderate.

Granger Causality Analysis

There is Granger causality at the 1% level. The GC test result confirms the statistical usefulness or the predictive value of the oil price variable for the steel export variable.

Trade Distance Analysis

The Dominican Republic does not produce coking coal domestically. Therefore, the coking coal used for steelmaking needs to be imported. No information is available for the Dominican Republic on iron ore production, imports or exports.

Importing coking coal from the U.S. involves short trade distances (U.S. South Coast: 3,071km; U.S. East Coast: 2,971km). Importing iron ore from the second-largest exporting country Brazil, however, includes a long trade distance (6,851km). Alternatively, iron ore might also be imported from the net exporters Canada and the United States. It is unlikely that steelmaking raw materials are imported from remote Australia.

Steel export trade distances to the U.S. East Coast (3,061km) and Gulf Coast (3,042km) are short.

Competitiveness Analysis

The Dominican Republic is an industrialising country ranked 98th in the GCI of 2008/2009. The Caribbean country is ranked below average in the sub-categories overall infrastructure (rank 75), port infrastructure (rank 74), domestic market size (rank 71) and foreign market size (rank 95).

No data are available about the Dominic Republic's manufacturing wages and hourly compensation costs. However, it is expected that labour costs are generally lower in the industrialising Dominican Republic than in the industrialised United States.

Conclusion

The increase in Dominican steel exports to the U.S. following a one-standard deviation oil price shock may be a combination of moderate upstream and short downstream trade distances and low labour costs.

In the competitiveness categories included in the analysis, the Dominican Republic performs below average by international standards.

It needs to be mentioned that the estimates for the Dominican Republic may be impacted by autocorrelation and should therefore be interpreted with caution.

6.2.4.4 El Salvador

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to an increase of El Salvador's steel exports to the U.S. which lasts for seven months. The impulse response peak is reached seven months after the shock at 269qmt. The impulse response values for periods four (68% error bands), six (68% error bands), and seven (90% error bands) are statistically significant.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 18.3% of the volatility in the steel export variable which indicates that the relative importance of the oil price variable for the steel export variable is moderate.

Granger Causality Analysis

There is no Granger causality at the 1%, 5% or 10% level.

Trade Distance Analysis

El Salvador does not produce coking coal domestically. Therefore, the coking coal used for steel production needs to be imported. No information is available for El Salvador on iron ore production, imports or exports.

Importing coking coal from the U.S. involves a moderate trade distance by international standards (U.S. South Coast: 4,450km). If iron ore imports are required, importing iron ore from the second-largest exporting country Brazil involves long-distance trade (9,488km). However, iron ore might also be imported from the U.S. or Canada. It is unlikely that steelmaking raw materials are imported from remote Australia.

Steel export trade distances to the U.S. are moderate (U.S. West Coast: 4,054km; U.S. South Coast: 4,424km).

Competitiveness Analysis

El Salvador is in the transition phase from a developing country to an industrialising country and is placed on position 79 in the GCI of 2008/2009. The country is among the top 50 nations in the overall infrastructure ranking (rank 48). Its rankings in terms of port infrastructure (rank 81), domestic market size (rank 76) and foreign market size (rank 95) are below average.

No data are available about El Salvador's manufacturing wages and hourly compensation costs. However, it can be assumed that labour costs are lower in the developing country than in the industrialised United States.

Conclusion

The partly statistically significant increase in El Salvadorian steel exports to the U.S. following a one-standard deviation oil price shock may be a combination of moderate trade distances and low labour costs.

In the competitiveness categories included in the analysis, El Salvador performs below average with the exception of overall infrastructure.

6.2.4.5 Guatemala

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to an increase of Guatemala's steel exports to the U.S. which lasts for one month. The impulse response value is statistically insignificant.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 5.3% of the volatility in the steel export variable. This indicates that the relative importance of the oil price variable for the steel export variable is rather low.

Granger Causality Analysis

The Granger test results indicate that there is no Granger causality at the 1% 5% or 10% level. However, the p-value (0.11) for the GC test is almost significant at the 10% level.

Trade Distance Analysis

Guatemala does not produce coking coal domestically. Therefore, the coking coal used for steel production needs to be imported. No information is available for Guatemala on iron ore production, imports or exports.

Importing coking coal from the U.S. Gulf Coast to Guatemala's east coast involves a short trade distance of 1,813km. Importing iron ore from the second-largest exporting country Brazil involves long-distance trade (8,734km). However, iron ore might also be imported from the U.S. or Canada. It is unlikely that steelmaking raw materials are imported from remote Australia.

Steel export trade distances to the U.S. are very low by international standards if Guatemala exports steel from its east coast to the U.S. Gulf Coast (1,785km).

Competitiveness Analysis

Guatemala is in the transition phase from a developing country to an industrialising country and is placed 84th in the GCI of 2008/2009. The country is ranked average in the competitiveness categories overall infrastructure (rank 63), port infrastructure (rank 63) and domestic market size (rank 68). The country performs below average in the foreign market size ranking (rank 96).

No data are available about Guatemala's manufacturing wages and hourly compensation costs. However, it is likely that labour costs are lower in the developing country than in the industrialised United States.

Conclusion

The increase of Guatemala's steel exports to the U.S. following a one-standard deviation oil price shock may be a combination of short/moderate upstream and downstream trade distances and low labour costs. However, the increase is short and statistically insignificant.

This may, amongst other things, be due to the fact that in the competitiveness categories included in the analysis, Guatemala performs average or below average by international standards.

6.2.4.6 Honduras

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to an increase of Honduras's steel exports to the U.S. which lasts for seven months. The impulse response peak is reached four months after the shock at 20qmt. The impulse response values for periods three and four are statistically significant at 68% error bands.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price contributes 7.3% of the volatility in the steel export variable. Therefore, the relative importance of the oil price variable for the steel export variable is rather low.

Granger Causality Analysis

There is no Granger causality at the 1%, 5% or 10% level.

Trade Distance Analysis

Honduras does not produce coking coal domestically. Therefore, the coking coal used for steel production needs to be imported. No information is available for Honduras on iron ore production, imports or exports.

Importing coking coal from the U.S. Gulf Coast to Honduras's east coast involves a very short trade distance of 1,859km. Importing iron ore from the second-largest exporting country Brazil involves long-distance trade (8,468km). Alternatively, iron ore might also be imported from the U.S. or Canada. It is unlikely that steelmaking raw materials are imported from remote Australia.

Steel export trade distances to the U.S. are very low if Honduras exports steel from its east coast to the U.S. Gulf Coast (1,833km).

Competitiveness Analysis

Honduras is a developing country placed 82nd in the GCI of 2008/2009. While the quality of the country's overall infrastructure is below average (rank 72), the quality of its port infrastructure is above average (rank 36). The country's domestic (rank 83) and foreign market size (rank 88) are ranked below average.

No data are available for Honduras about manufacturing wages and hourly compensation costs. However, it is likely that labour costs are lower in the developing country than in the industrialised United States.

Conclusion

The partially statistically significant increase of Honduras' steel exports to the U.S. following a one-standard deviation oil price shock may be a combination of short upstream and downstream trade distances, solid port infrastructure, and low labour costs.

It needs to be mentioned that the estimates for Honduras may be impacted by serial correlation and should therefore be interpreted with caution.

6.2.4.7 Mexico

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to an increase of Mexican steel exports to the U.S. which lasts for seven months. The impulse response peak is reached five months after the shock at 7,845qmt. The impulse response value for period five is statistically significant at 68% error bands.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 14.5% of the volatility in the steel export variable. Therefore, the relative importance of the oil price variable for the steel export variable is moderate.

Granger Causality Analysis

There is no Granger causality at the 1%, 5% or 10% level.

Trade Distance Analysis

Mexico produces coking coal domestically (2008: 2,286tst) and is a net importer of iron ore (2008; 1,923tmt).

Importing iron ore from the second-largest iron ore exporter Brazil involves long-distance trade (9,871km). Therefore, it is possible that iron ore is also imported from the neighbouring United States. If coking coal needs to be imported, the distance of trade is very short when imports come from the U.S. Gulf Coast (1,591km). It is unlikely that significant amounts of coking coal or iron ore are imported from remote Australia.

Downstream trade distances for steel exports to the U.S. are short/very short. Transporting steel from the Mexican west coast (Veracruz) to the U.S. West Coast (Long Beach) involves a short trade distance of 2,363km while transporting steel from the Mexican east coast (Manzanillo) to the U.S. Gulf Coast involves a very short trade distance of only 1,448km. Even steel exports from Mexico's east coast to the U.S. East Coast (New York) only involve a short trade distance (3,866km). Moreover, steel can be exported to the U.S. by using overland transport. The multiple transport routes/options and the short trade distances from Mexico to the U.S. provide a considerable advantage over most countries exporting steel to the U.S., especially at high oil price levels.

Competitiveness Analysis

Mexico is an industrialising country ranked 60th in the GCI of 2008/2009. Mexico is among the top twenty nations in terms of domestic (rank 12) and foreign market size (rank 16). The quality of Mexico's overall (rank 76) and port infrastructure (rank 94) is below average by international standards.

Mexico has a considerable comparative advantage over the U.S. in hourly compensation costs (primary metal manufacturing: \$5.81 vs. \$31.82; fabricated product manufacturing: \$3.39 vs. \$26.15). No information is available about Mexican manufacturing wages but they are expected to be below U.S. manufacturing wages.

Conclusion

The partially statistically significant increase of Mexican steel exports to the U.S. may be due to short upstream and downstream trade distances, multiple transport routes/options, low labour costs, the common border with Maquiladoras operating in the border area, and the NAFTA membership. Additionally, Mexican steel exports to the U.S. are analysed per steel export category in section 6.4.4.2.

6.2.4.8 Panama

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to an increase of Panama's steel exports to the U.S. which lasts for two months. The impulse response peak is reached two months after the shock at 18qmt. The increase in steel exports is statistically insignificant.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 14.3% of the volatility in the steel export variable. Therefore, the relative importance of the oil price variable for the steel export variable is moderate.

Granger Causality Analysis

There is Granger causality at the 1% level. The GC test result confirms the statistical usefulness or the predictive value of the oil price variable for the steel export variable.

Trade Distance Analysis

Panama does not produce coking coal domestically. Therefore, the coking coal used for steel production needs to be imported. No information is available for Panama on iron ore production, imports or exports.

Importing coking coal from the U.S. Gulf Coast involves a short trade distance of 2,741km if the imports arrive at Panama's northern coast. If iron ore needs to be imported, imports from the second-largest exporting country Brazil involve long-distance trade (7,777km). However, iron ore might also be imported from the U.S. or Canada. It is unlikely that steelmaking raw materials are imported from remote Australia.

Steel export trade distances to the U.S. are short if Panama exports steel from its northern coast to the U.S. Gulf Coast (2,713km).

Competitiveness Analysis

Panama is an industrialising country placed 58th in the GCI of 2008/2009. While the quality of its overall infrastructure is average (rank 54), Panama's port infrastructure is well-developed (rank 15). The country's domestic market size (rank 73) is average by international standards. Its foreign market size is below average (rank 92).

No data are available about Panama's manufacturing wages and hourly compensation costs. However, it is expected that labour costs are lower in the industrialising country than in the industrialised United States.

Conclusion

The statistically insignificant increase of Panama's steel exports to the U.S. following a one-standard deviation oil price shock may be a combination of moderate upstream and downstream trade distances, good port infrastructure, and low labour costs. The insignificance of the increase may, amongst other things, be due to underdeveloped overall infrastructure and the inabaility to generate economies of scale because of low market size.

6.2.4.9 Trinidad and Tobago

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to a positive response in Trinidad and Tobago's steel exports to the U.S. which lasts for two months. The impulse response peak is reached one month after the shock at 1,012qmt. The impulse response value for period one is statistically significant at 68% error bands.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 12.6% of the volatility in the steel export variable. Therefore, the relative importance of the oil price variable for the steel export variable is moderate.

Granger Causality Analysis

There is no Granger causality at the 1%, 5% or 10% level.

Trade Distance Analysis

Trinidad and Tobago does not produce coking coal domestically. Therefore, the coking coal used for steel production needs to be imported. The country also imports significant amounts of iron ore (2008: 4,252tmt).

Importing coking coal from the U.S. East Coast involves short-distance trade (3,721km). Importing iron ore from the second-largest exporting country Brazil involves moderate-distance trade (5,691km). Alternatively, iron ore might also be imported from the U.S. or Canada. It is unlikely that steelmaking raw materials are imported from remote Australia.

Steel export trade distances to the U.S. are short if Trinidad and Tobago exports steel to the U.S. East Coast (3,955km).

Competitiveness Analysis

Trinidad and Tobago is placed 92nd in the GCI of 2008/2009. While the quality of the country's overall infrastructure is average by international standards (rank 60) its port infrastructure is underdeveloped (rank 89) and its domestic (rank 86) and foreign market size (rank 112) are quite small.

No data are available about Trinidad and Tobago's manufacturing wages and hourly compensation costs. It can be assumed that labour costs are lower in the industrialising country than in the industrialised United States.

Conclusion

The statistically significant increase of Trinidad and Tobago's steel exports to the U.S. following a one-standard deviation oil price shock may be a combination of moderate upstream and downstream trade distances and low labour costs.

A stronger increase of steel exports to the U.S. may, amongst other things, be hampered by underdeveloped infrastructure and low market size.

6.2.4.10 Summary

The steel export volumes to the U.S. of the nine North American countries all increase following a one-standard deviation oil price shock. In seven of nine cases, the increase is statistically significant. Thereby, the upstream trade distances for the import of steelmaking raw materials and downstream trade distances for the export of steel products to the U.S. are mostly short or moderate.

Comparing the impulse response estimates for both neighbouring countries of the U.S., Canada and Mexico reveals the following: Although the increase of Mexican steel exports to the U.S. lasts longer, the Canadian impulse response estimate consists of more statistically significant impulse response values.

Both countries have common borders with the U.S., are NAFTA members, and are among the top twenty nations in terms of market size (domestic: rank 13 (Canada) vs. rank 12 (Mexico); foreign: rank 15 (Canada) vs. rank 16 (Mexico).

However, while industrialising Mexico has a significant comparative advantage over industrialised Canada in terms of labour costs (primary metal manufacturing: \$5.81 vs. \$44.71; fabricated product manufacturing: \$3.39 vs. \$29.59), Canada has advantages in terms of steelmaking raw material abundance, infrastructure (overall infrastructure: rank 10 (Canada) vs. rank 76 (Mexico); port infrastructure: rank 14 (Canada) vs. rank 94 (Mexico)), and overall competitiveness (rank 10 (Canada) vs. rank 60 (Mexico)).

It seems that Canada's advantages in raw material abundance, infrastructure and overall competitiveness may outbalance Mexico's comparative advantage of labour costs. Additionally, it would be interesting to compare the composition of exports (high-value vs. low-value products) of both countries to estimate whether the value of steel products exported does make a difference.

With regard to the other North American countries analysed, the following can be said: All countries other than Canada and Mexico (Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, Panama, Trinidad and Tobago) are developing or industrialising countries with small economies.

All countries are ranked average or below average in the competitiveness rankings used for analysis (overall competitiveness: rank 58-98; overall infrastructure: rank 54-103; port infrastructure: rank 63-128 [exceptions: Honduras: rank 36; Panama: rank 15]; domestic market size: rank 68-112; foreign market size: rank 73-96). However, it seems that the combination of low labour costs and short/medium upstream and downstream trade distances at high oil prices is strong enough to outbalance the rather low international competitiveness of the small North American economies.

Recapitulatory, the findings for the North American countries included in the analysis are in line with the hypothesis that oil price shocks or rising (maritime) fuel costs lead to a regionalisation of trade flows and a reduction of trade distances in the global steel industry.

6.2.5 South America

Section 6.2.5 analyses the econometric estimates for Argentina (6.2.5.1), Brazil (6.2.5.2), Chile (6.2.5.3), Colombia (6.2.5.4), Ecuador (6.2.5.5), Peru (6.2.5.6), and Uruguay (6.2.5.7). Section 6.2.5.8 concludes.

Table 6.10 VEC Analysis - South America

Country	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
Argentina	1	-387.090	7.9	0.10
Brazil	1	1,151.662	11.0	0.26
Chile	1	541.961	5.0	0.83
	2	919.474		
	3	1,590.101		
	4	525.688		
	5	1,768.352 *		
Colombia	1	261.985 *	29.5	0.04
	2	284.708 *		
Ecuador	1	-6.116	10.6	0.66
Peru	1	7.936	17.8	0.87
Uruguay	1	-5.291	1.0	0.02
	2	-11.868		

Source:
Author's calculations (EViews®)

* statistically significant at 68% error bands
** statistically significant at 90% error bands
*** statistically significant at 95% error bands

6.2.5.1 Argentina

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to a decrease of Argentinian steel exports to the U.S. which lasts for one month (-387qmt). The decrease is statistically insignificant.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 7.9% of the volatility in the steel export variable. This indicates that the relative importance of the oil price variable for the steel export variable is low.

Granger Causality Analysis

The Granger test results indicate that there is no Granger causality at the 1%, 5% or 10% level. However, the p-value (0.104) of the Granger causality test is nearly significant at the 10% level.

Trade Distance Analysis

Argentina produces coking coal domestically (2008: 2,199tst). The South American country imports significant amounts of iron ore (2008: 7,176tmt).
Importing iron ore from neighbouring Brazil involves short-distance trade (2,580km). Alternatively, overland transport could also be used for iron ore imports from Brazil. In case of coking coal imports, importing from the U.S. would involve very long-distance trade (11,258km). It is unlikely that significant amounts of steelmaking raw materials are imported from remote Australia. Steel export trade distances to the U.S. are very long if Argentina exports steel to the U.S. East Coast (11,352km).

Competitiveness Analysis

Argentina is an industrialising country placed 88th in the GCI of 2008/2009. The country is ranked above average in terms of domestic (rank 21) and foreign market size (rank 38) but its infrastructure is underdeveloped (overall infrastructure: rank 89; port infrastructure: rank 92).
Argentina has a comparative advantage over the U.S. in manufacturing wages ($5.47 vs. $21.50) and hourly compensation costs (primary metal manufacturing: $11.73 vs. $31.82; fabricated product manufacturing: $6.50 vs. $26.15).

Conclusion

The short and statistically insignificant decline of Argentinian steel exports to the U.S. may, amongst other things, be due to long downstream trade distances and the country's underdeveloped infrastructure. The decline may be limited by domestic coking coal production, short trade distances for iron ore imports, and low labour costs.

6.2.5.2 Brazil

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to an increase of Brazilian steel exports to the U.S. which lasts for one month (1,151qmt). The increase is statistically insignificant.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 11% of the volatility in the steel export variable. Therefore, the relative importance of the oil price variable for the steel export variable is moderate.

Granger Causality Analysis

There is no Granger causality at the 1%, 5% or 10% level.

Trade Distance Analysis

Although Brazil produces coking coal domestically (2008: 9,133tst), the country is one of the largest importers of coking coal (2006: 19Mt). On the other hand, Brazil is the second-largest exporter of iron ore worldwide.

Importing coking coal from the U.S. East Coast involves moderate-distance trade if the port of destination is on Brazil's northern coast (5,780km) and long-distance trade if the port of destination is on Brazil's eastern coast (9,156km). Importing coking coal from Australia to Brazil`s east coast involves very long-distance trade (16,480km).

Exporting steel to the U.S. involves moderate-distance trade if the port of departure is located on Brazil's northern coastline and the port of arrival is located on the U.S. East Coast (5,876km).

Competitiveness Analysis

Brazil is an industrialising country placed 64th in the GCI of 2008/2009. The country is among the top ten nations in terms of domestic market size (rank 9) and quite competitive in terms of foreign market size (rank 23). Brazil's infrastructure (overall infrastructure: rank 98; port infrastructure: rank 123) is severely underdeveloped.

The country has a comparative advantage over the U.S. in manufacturing wages ($3.81 vs. $21.50) and hourly compensation costs (primary metal manufacturing: $12.27 vs. $31.82; fabricated product manufacturing: $5.95 vs. $26.15).

Conclusion

The increase of Brazilian steel exports to the U.S. may be due to domestic iron ore availability, moderate upstream (coking coal) and downstream (steel exports to the U.S.) trade distances, low labour costs, and relatively large market size making possible economies of scale if the steel industry is not too fragmented. One factor contributing to the shortness and statistical insignificance of the increase may be the drastically underdeveloped infrastructure of the country. Additionally, Brazilian steel exports to the U.S. are analysed per steel export category in section 6.4.5.

6.2.5.3 Chile

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to an increase of Chile's steel exports to the U.S. which lasts for five months. The impulse response peak is reached five months after the shock at 1,768qmt. The impulse response value for period five is statistically significant at 68% error bands.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 5% of the volatility in the steel export variable. Therefore, the relative importance of the oil price variable for the steel export variable is low.

Granger Causality Analysis

There is no Granger causality at the 1%, 5% or 10% level.

Trade Distance Analysis

Chile produces coking coal domestically (2008: 547tst) and is a significant exporter of iron ore (2008: 5,400tmt). In case additional coking coal needs to be imported, imports from the U.S. Gulf Coast involve long-distance trade (7,849km) and imports from Australia involve very long-distance trade (12,642km). Steel exports to the U.S. Gulf Coast involve long-distance trade (7,756km).

Competitiveness Analysis

Chile is in the transition phase from an industrialising to an industrialised country and is placed 28th in the GCI of 2008/2009. The country is among the top 50 nations in terms of domestic (rank 47) and foreign market size (rank 43) and is quite competitive in terms of overall (rank 29) and port infrastructure (rank 37).

No data are available about Chile's manufacturing wages and hourly compensation costs. However, it is likely that labour costs are lower in industrialising Chile than in the industrialised United States.

Conclusion

Chile's partially statistical significant increase in steel exports to the U.S. following a one-standard deviation oil price shock may be fostered by relative domestic steelmaking raw material abundance, low labour costs, and overall competitiveness.

6.2.5.4 Colombia

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to an increase of Colombian steel exports to the U.S. which lasts for two months. The impulse response peak is reached two months after the shock at 285qmt. The impulse response values for periods one and two are statistically significant at 68% error bands.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 29.5% of the volatility in the steel export variable. This means that the relative importance of the oil price variable for the steel export variable is high.

Granger Causality Analysis

There is Granger causality at the 5% level. The GC test result confirms the statistical usefulness or the predictive value of the oil price variable for the steel export variable.

Trade Distance Analysis

Colombia produces coking coal domestically (2008: 547tst) and is one of the most significant exporters of coking coal (2010: 1Mt). No data are available for Colombian iron ore imports or exports. In 2008, Colombian iron ore production was 900tmt. By and large, the Colombian steel industry profits from steelmaking raw material abundance.

In addition to domestic production, iron ore might be imported from neighbouring Brazil. This would involve long-distance trade if the iron ore would be transported by sea from

Brazil's east coast (7,791km). Alternatively, imports from Brazil might be transported overland. Iron ore may also be imported from the United States.

Exporting steel from Colombia to the U.S. involves short-distance trade if the steel products are exported to the U.S. Gulf Coast (2,763km) or to the U.S. East Coast (3,653km).

Competitiveness Analysis

Colombia is an industrialising country placed 74th in the GCI of 2008/2009. The country is among the top 30 nations in terms of domestic market size (rank 30) and is ranked above average in terms of foreign market size (rank 54). Colombia's infrastructure (overall infrastructure: rank 84; port infrastructure: rank 108) is underdeveloped.

No data are available about Colombian manufacturing wages and hourly compensation costs. However, it is likely that labour costs are lower in industrialising Colombia than in the industrialised United States.

Conclusion

The statistically significant increase of Colombian steel exports to the U.S. following a one-standard deviation oil price shock is likely to be facilitated by steelmaking raw material abundance, short downstream trade distances and low labour costs.

The significantly underdeveloped infrastructure may be one factor preventing a stronger increase of steel exports to the United States.

6.2.5.5 Ecuador

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to a decrease of Ecuadorian steel exports to the U.S. which lasts for one month (-6qmt). The decrease is statistically insignificant.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 10.6% of the volatility in the steel export variable. Therefore, the relative importance of the oil price variable for the steel export variable is moderate.

Granger Causality Analysis

There is no Granger causality at the 1%, 5% or 10% level.

Trade Distance Analysis

Ecuador does not produce coking coal domestically. Therefore, the coking coal used in the steel production process needs to be imported. No information is available for Ecuador's iron ore production, imports or exports.

Importing coking coal from the U.S. Gulf Coast involves moderate trade distances (4,130km). Alternatively, coking coal might also be imported from neighbouring Colombia. Importing iron ore from the second-largest exporter Brazil involves long-distance trade (9,167km). Alternatively, iron ore might also be imported from the United States. It is rather unlikely that significant amounts of coking coal or iron ore are imported from remote Australia.

Exporting steel from Ecuador to the U.S. involves a moderate trade distance if the steel products are exported to the U.S. Gulf Coast (4,104km).

Competitiveness Analysis

Ecuador is an industrialising country placed 104th in the GCI of 2008/2009. The country's market size (domestic: rank 59; foreign: rank 72) is average international standards. Ecuador's overall (rank 105) and port infrastructure (rank 109) is significantly underdeveloped.

No data are available about Ecuadorian manufacturing wages and hourly compensation costs. However, it is expected that labour costs are lower in industrialising Ecuador than in the industrialised United States.

Conclusion

Ecuador's short and statistically insignificant decrease of steel exports to the U.S. may be fostered by steelmaking resource scarcity, the country's overall un-competitiveness, and the underdeveloped infrastructure.

The decrease of steel exports may be relatively short and statistically insignificant because of short/moderate upstream and downstream trade distances and low labour costs.

6.2.5.6 Peru

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to an increase of Peru's steel exports to the U.S. which lasts for one month (8qmt). This increase in steel exports is statistically insignificant.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 17.8% of the volatility in the steel export variable which means that the relative importance of the oil price variable for the steel export variable is moderate.

Granger Causality Analysis

There is no Granger causality at the 1%, 5% or 10% level.

Trade Distance Analysis

Peru does not produce coking coal domestically (Peru produced coking coal domestically until 2006 (53tst). However, Peru did not produce coking coal in 2007 and 2008.). Therefore, the coking coal used for steelmaking needs to be imported. Peru is a significant exporter of iron ore (2008: 7,200tmt).

Importing coking coal from the U.S. Gulf Coast involves moderate trade distances (5,347km). Alternatively, coking coal might also be imported from neighbouring Colombia by sea or by using overland transport. It is rather unlikely that Peru imports significant amounts of coking coal from remote Australia.

Exporting steel from Peru to the U.S. involves moderate-distance trade if the steel products are exported to the U.S. Gulf Coast (5,318km).

Competitiveness Analysis

Peru is an industrialising country placed 88^{th} in the GCI of 2008/2009. While Peru's overall (rank 113) and port infrastructure (rank 127) is dramatically underdeveloped, it consists of a solid domestic (rank 45) and foreign market size (rank 55).

No data are available about Peru's manufacturing wages and hourly compensation costs. However, it is expected that labour costs are lower in industrialising Peru than in the industrialised United States.

Conclusion

Peru's short increase in steel exports to the U.S. following a one-standard deviation oil price shock may be due to relative steelmaking raw material abundance, moderate upstream and downstream trade distances, low labour costs and solid market size.

One reason contributing to the shortness and insignificance of the increase may be the country's massively underdeveloped infrastructure.

6.2.5.7 Uruguay

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to a decrease of Uruguay's steel exports to the U.S. which lasts for two months. The peak of the decline is reached after two months at -12qmt. The decline is statistically insignificant.

Variance Decomposition

Fifteen months after the shock, the oil price variable accounts for 1% of the volatility in the steel export variable. Therefore, the relative importance of the oil price variable for the steel export variable is very low.

Granger Causality Analysis

There is Granger causality at the 5% level. The GC test result confirms the statistical usefulness or the predictive value of the oil price variable for the steel export variable.

Trade Distance Analysis

Uruguay does not produce coking coal domestically. Therefore, the coking coal used for steel production needs to be imported. No data are available for Uruguay on iron ore production, imports or exports.

Importing coking coal from the U.S. East Coast (11,043km) or Australia (15,079km) involves very long trade distances while iron ore imports from neighbouring Brazil involves short-distance trade (2,365km).

Exporting steel from Uruguay to the U.S. East Coast (11,138km) involves very long distance trade.

Competitivenes Analysis

Uruguay is an industrialising country placed 75th in the GCI of 2008/2009. While Uruguay's overall (rank 66) and port infrastructure (rank 50) is ranked average, its market size is below average (domestic: rank 87; foreign: rank 94) by international standards.

No data are available about Uruguay's manufacturing wages and hourly compensation costs. It can be expected that labour costs are lower in industrialising Uruguay than in the industrialised United States.

Conclusion

The two-month decrease of steel exports from Uruguay to the U.S. following a one-standard deviation oil price shock may be due to very long upstream (coking coal) and downstream trade distances. The downturn may be comparatively short and statistically insignificant because of low upstream trade distances for iron ore, low labour costs, and the country's solid infrastructure.

6.2.5.8 Summary

The seven South American countries included in the analysis have the following in common: They are all industrialising countries, have a comparative advantage over the United States in terms of labour costs, and are not landlocked.

At first view the impulse response estimates of the South American countries appear to be quite different. While the impulse responses estimates of four countries indicate increasing steel exports to the U.S., the estimates for three countries indicate decreasing steel exports. Thereby, none of the decreasing impulse response estimates is statistically significant, while the impulse response estimates indicating increasing steel exports are statistically significant for Colombia and Chile.

The Colombian steel industry profits from steelmaking raw material abundance and the shortest downstream trade distance to the U.S. of all South American countries analysed.

Chile's steel industry also profits from steelmaking raw material abundance but - other than Colombia - faces long downstream trade distances to the United States. This disadvantage of long downstream trade distances seems to be counterbalanced by the outstanding overall competitiveness of its economy (rank 28) by South American standards. In terms of overall competitiveness the performance of the other South American countries is well below Chilean standards (ranks 64-104). In terms of overall (rank 29) and port infrastructure (rank 37), Chile also performs significantly better than the other countries (overall infrastructure: ranks 66-113; port infrastructure: ranks 50-127). Chile's competitiveness may contribute to the partially statistically significant increase of its steel exports to the United States.

Besides Colombia and Chile, two other countries located on the South American west coast are analysed. Both Ecuador and Peru do not profit significantly from increasing oil prices in terms of steel exports to the United States. While Ecuador's steel exports decrease marginally, Peru's steel exports increase marginally. Both countries are not resource abundant and are less competitive (Ecuador: rank 104; Peru: rank 83) than Colombia (rank 74) and Chile (rank: 28). More specifically, the infrastructure of Ecuador and Peru is also less competitive than the infrastructure of Chile and Colombia. It may be that for those reasons, Chile and Colombia profit from a shock in the oil price variable while Ecuador and Peru do not.

Three countries are located on South America's eastern coastline, Argentina, Brazil, and Uruguay. The impulse responses for the two large economies on the eastern coastline, Argentina and Brazil, have opposing trends. While steel exports from Brazil to the U.S. increase for one month following an oil price shock, steel exports from Argentina decrease for one month. Thereby, both impulse response estimates are statistically insignificant. There are several reasons why the Brazilian steel industry may perform better than the Argentinian steel industry with regard to steel exports to the United States. First, Brazil has a favorable geographical position. Exporting steel from Brazil's northern coast to the U.S. East Coast involves only moderate downstream trade distances while exporting from Brazil's eastern coast involves long-distance trade. On the other hand, exporting from Argentina's eastern coast to the U.S. involves very long-distance trade. At high oil price levels, transport distance can make the difference between increasing and decreasing export figures. Second, Brazil is better off than Argentina in terms of steelmaking raw material abundance. Third, Brazil performs better than Argentina in terms of overall competitiveness (rank 64 vs. rank 88) and market size (domestic: rank 9 vs. rank 21; foreign: rank 23 vs. rank 38). Argentina performs better in terms of infrastructure (overall infrastructure: rank 89 vs. rank 98; port infrastructure: rank 92 vs. rank 123).

For Uruguay, which is geographically located between Argentina and Brazil, the decline in steel exports to the U.S. is somewhat longer but also statistically insignificant. The country faces the same disadvantages as Argentina when compared to Brazil in terms of trade distance, raw material abundance, overall competitiveness, and market size. One possible reason for the longer downturn of Uruguay's steel exports may be an edge of the Argentinian and Brazilian steel industries with regard to economies of scale.

Recapitulatory, it seems that the steel industries of the South American countries geographically located at South America's northern coast (Colombia, Brazil) profit from moderate export trade distances to the U.S. at high oil price levels while the countries located further down along South America's east coast suffer from very long distance trade (Argentina, Uruguay). The steel industries of countries located on the northern part of South America's west coast (Ecuador, Peru) seemingly neither profit nor suffer from rising oil prices. At the same time, the steel industry of Chile, which is located on the southern part of South America's west coast, profits significantly, mainly due to its superior overall competitiveness in relation to the other South American countries.

By and large, the findings for the South American countries included in the analysis are in line with the hypothesis that oil price shocks or rising maritime fuel costs lead to a regionalisation of trade flows and to a reduction of long-distance trade in the global steel industry.

6.2.6 Africa

Section 6.2.6 analyses the econometric estimates for Algeria (6.2.6.1), Egypt (6.2.6.2) and South Africa (6.2.6.3). Section 6.2.6.4 concludes.

Table 6.11 VEC Analysis - Africa

Country	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
Algeria	1	-869.301 *	21.8	0.28
Egypt	1	-2,675.453 *	27.8	0.16
South Africa	1	-2,644.455 *	14.5	0.40
	2	-837.055		
	3	-1,792.707 *		
	4	-1,714.865		
	5	-2,697.606 *		
	6	-1,060.836		

Source:
Author's calculations (EViews®)

* statistically significant at 68% error bands
** statistically significant at 90% error bands
*** statistically significant at 95% error bands

6.2.6.1 Algeria

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to a decrease of Algerian steel exports to the U.S. which lasts for one month (-869qmt) and is statistically significant at 68% error bands.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 21.8% of the volatility in the steel export variable. This indicates that the relative importance of the oil price variable for the steel export variable is high.

Granger Causality Analysis

There is no Granger causality at the 1%, 5% or 10% level.

Trade Distance Analysis

Algeria produces coking coal domestically (2008: 684tst). In addition to its domestic production (2008: 1,700tmt), the North African country requires additional imports of iron ore (2008: 213tst).

Importing iron ore from one of the largest exporting countries involves long/very long-distance trade (Australia: 14,820km; Brazil: 8,427km). Importing coking coal in addition to national production would also involve long/very long trade distances (Australia: 19,142km; U.S. East Coast: 7,280km).

Exporting steel from Algeria to the U.S. East Coast also involves long-distance trade (6,907km).

Competitiveness Analysis

Algeria is an industrialising country placed 99th in the GCI of 2008/2009. While Algeria's infrastructure is underdeveloped (overall infrastructure: rank 85; port infrastructure: rank 103), its market size is above average (domestic: rank 52; foreign: rank 41).

No data are available about Algeria's manufacturing wages and hourly compensation costs. It is likely that labour costs are lower in industrialising Algeria than in the industrialised United States.

Conclusion

The statistically significant downturn of Algerian steel exports to the U.S. following a one-standard deviation oil price shock may be facilitated by long downstream trade distances and underdeveloped infrastructure.

The long or very long trade distances involved in importing steelmaking raw materials can be balanced to a certain extent by domestic production. Finally, the decrease of steel exports might be confined by a comparative advantage in labour costs in relation to the United States.

6.2.6.2 Egypt

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to a reduction of Egyptian steel exports to the U.S. which lasts for one month (-2,675qmt) and is statistically significant at 68% error bands.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 27.8% of the volatility in the steel export variable. Therefore, the relative importance of the oil price variable for the steel export variable is high.

Granger Causality Analysis

There is no Granger causality at the 1%, 5% or 10% level.

Trade Distance Analysis

Egypt produces coking coal domestically (2008: 1,620tst). In addition to its domestic production (2008: 2,000tmt), Egypt requires additional iron ore imports (2008: 3,562tst).

Importing iron ore from one of the largest exporting countries involves very long distance trade (Australia: 12,238km; Brazil: 11,045km). If coking coal imports would be necessary in addition to national production, long/very long trade distances (Australia: 16,559km; U.S. East Coast: 9,899km) would be involved.

Exporting steel from Egypt to the U.S. also involves long-distance trade (U.S. East Coast: 6,907km).

Competitiveness Analysis

Egypt is a developing country placed 81st in the GCI of 2008/2009. The Egyptian steel industry can resort to a solid infrastructure (overall infrastructure: rank 57; port infrastructure: rank 69) and the country's market size is well above average (domestic: rank 22; foreign: rank 36).

No data are available about Egypt's manufacturing wages and hourly compensation costs. It is expected that labour costs are lower in developing Egypt than in the industrialised United States.

Conclusion

The statistically significant downturn of Egyptian steel exports to the U.S. following a one-standard deviation oil price shock may be facilitated by long and very long upstream and downstream trade distances.

The decrease of steel exports to the U.S. might be confined by a comparative labour cost advantage over the U.S., and by Egypt's market size which is above average and might help to generate economies of scale if the national steel industry is not too fragmented.

6.2.6.3 South Africa

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to a decline of South African steel exports to the U.S. which lasts for six months. The impulse response peak is reached five months after the shock at -2,698qmt. The impulse response values for periods one, three, and five are statistically significant at 68% error bands.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 14.5% of the volatility in the steel export variable which indicates that the relative importance of the oil price variable for the steel export variable is moderate.

Granger Causality Analysis

There is no Granger causality at the 1%, 5% or 10% level.

Trade Distance Analysis

South Africa is one of the largest exporters of coking coal (2008: 1Mt) and iron ore (2008: 31,592tmt). Therefore, its steel industry has a comparative advantage due to raw material abundance.

Exporting steel from South Africa to the U.S. East Coast involves very long distance trade (14,627km).

Competitiveness Analysis

South Africa is an industrialising country placed on position 45 in the GCI of 2008/2009. The country is ranked in the top fifty in terms of overall (rank 46) and port infrastructure (rank 49). South Africa's domestic (rank 22) and foreign market size (rank 36) is well above average.

No data are available about South African manufacturing wages and hourly compensation costs. It can be assumed that labour costs are lower in the industrialising country than in the industrialised United States.

Conclusion

The statistically significant downturn of South African steel exports to the U.S. in reaction to a one-standard deviation oil price shock lasts for six months. The main reason for the steel export reduction may be very long downstream trade distances between South Africa and the United States.

It seems that South Africa's competitiveness in infrastructure and market size and its comparative advantages due to steelmaking raw material abundance and low labour costs cannot counterbalance the negative impact of very long downstream trade distances at high oil price levels. Additionally, South African steel exports to the U.S. are analysed per steel export category in section 6.4.6.

6.2.6.4 Summary

Steel export volumes to the U.S. decline for the three African countries included in the analysis as a reaction to a one-standard deviation oil price shock. The reduction in steel exports is statistically significant for any of the countries analysed.

One of the main reasons for the declining steel export volumes seem to be long (Algeria, Egypt) and very long (South Africa) downstream trade distances.

The findings for the African countries included in the analysis are in line with the hypothesis that oil price shocks or rising maritime fuel costs lead to a regionalisation of trade flows and to a reduction of trade distances in the global economy.

6.2.7 Middle East

Section 6.2.7 analyses the econometric estimates for Israel (6.2.7.1), Saudi Arabia (6.2.7.2), Turkey (6.2.7.3) and the United Arab Emirates (6.2.7.4). Section 6.2.7.5 concludes.

Table 6.12 VEC Analysis - Middle East

Country	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
Israel	1	-481.493	15.5	0.31
	2	-275.161		
Saudi Arabia	1	-594.453 *	13.2	0.44
Turkey	1	-8,277.603 *	38.1	0.38
	2	-20,190.660 ***		
	3	-21,756.740 ***		
	4	-24,114.930 ***		
	5	-14,301.120 **		
	6	-10,558.410 *		
	7	-705.093		
United Arab Emirates	1	60.227	12.7	0.00
	2	61.517		

Source:
Author's calculations (EViews®)

* statistically significant at 68% error bands
** statistically significant at 90% error bands
*** statistically significant at 95% error bands

6.2.7.1 Israel

<u>Impulse Response Analysis</u>

A one-standard deviation shock to the real oil price leads to a decline of Israel's steel exports to the U.S. which lasts for two months. The impulse response peak is reached one month after the shock at -481qmt. The impulse response values are statistically insignificant.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 15.5% of the volatility in the steel export variable. Therefore, the relative importance of the oil price variable for the steel export variable is moderate.

Granger Causality Analysis

There is no Granger causality at the 1%, 5% or 10% level.

Trade Distance Analysis

Israel does not produce coking coal domestically. Therefore, the coking coal used in the steel production process needs to be imported. No data are available for Israeli iron ore production, imports, or exports.

Importing coking coal from one of the largest exporting countries involves very long trade distances (Australia: 16,611km; U.S. East Coast: 10,334km). If iron ore needs to be imported from one of the most significant exporting countries, the distance of trade would be very long as well (Australia: 12,290km; Brazil: 11,481km).

Exporting steel from Israel to the U.S. involves long-distance trade (U.S. East Coast: 9,961km).

Competitiveness Analysis

Israel is an industrialised country ranked 23rd in the GCI of 2008/2009. The country's infrastructure (overall infrastructure: rank 42; port infrastructure: rank 53) and market size (domestic: rank 48; foreign: rank 50) are above average by international standards.

Israel has a comparative advantage over the U.S. in manufacturing wages ($12.52 vs. $21.50) and hourly compensation costs (primary metal manufacturing: $13.20 vs. $31.82; fabricated product manufacturing: $12.38 vs. $26.15).

Conclusion

The statistically insignificant downturn of Israeli steel exports to the U.S. as a reaction to a one-standard deviation oil price shock lasts for two months and may be due to very long upstream and downstream trade distances.

The statistical insignificance of the downturn may amongst other things be due to Israel's comparative advantage in labour costs over the United States.

6.2.7.2 Saudi Arabia

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to a decline of Saudi Arabian steel exports to the U.S. which lasts for one month (-594qmt). The impulse response value is statistically significant at 68% error bands.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 13.2% of the volatility in the steel export variable. Therefore, the relative importance of the oil price variable for the steel export variable is moderate.

Granger Causality Analysis

There is no Granger causality at the 1%, 5% or 10% level.

Trade Distance Analysis

Saudi Arabia does not produce coking coal domestically. Hence, the coking coal used for steel production needs to be imported. Additionally, the Saudi Arabian steel industry also depends on iron ore imports (2008: 7,638tmt).

Importing coking coal from the most significant exporting countries involves very long distance trade (Australia: 15,060km; U.S. East Coast: 11,445km). The same applies for iron ore imports from the main exporting countries (Australia: 10,740km; Brazil: 12,592km).

Exporting steel products from Saudi Arabia to the U.S. East Coast involves very long trade distances as well (11,073km).

Competitiveness Analysis

Saudi Arabia is in the transition phase from a developing to an industrialising country. The country was placed 27th in GCI of 2008/2009. The quality of Saudi Arabia's overall (rank 38) and port infrastructure (rank 45) is above average. The country is among the top thirty nations in terms of domestic (rank 21) and foreign market size (rank 26).

No data are available about Saudi Arabian manufacturing wages and hourly compensation costs.

Conclusion

The short statistically significant downturn of Saudi Arabian steel exports to the U.S. following a one-standard deviation oil price shock may amongst other things be due to very long upstream and downstream trade distances.

The impact of the oil price shock may be reduced by the country's overall competitiveness, solid infrastructure, significant market size, and probably lower labour costs (no information is available for Saudi Arabian labour costs).

6.2.7.3 Turkey

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to a decline of Turkish steel exports to the U.S. which lasts for seven months. The impulse response peak is reached four months after the shock at -24,115qmt. The impulse response values for periods one (68% error bands), two, three, four (95% error bands), five (90% error bands), and six (68% error bands) are statistically significant.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 38.2% of the volatility in the steel export variable. Therefore, the relative importance of the oil price variable for the steel export variable is very high.

Granger Causality Analysis

There is no Granger causality at the 1%, 5% or 10% level.

Trade Distance Analysis

Turkey produces coking coal domestically (2008: 4,382tst). At the same time, the country is one of the largest coking coal exporters worldwide (2010: 7Mt). Although Turkey produces iron ore domestically (2008: 3,700tmt), it needs to import significant amounts of iron ore (2008: 6,900tmt).

Very long trade distances are involved when the main steelmaking raw materials coking coal (Australia: 17,813km; U.S. East Coast: 9,938km) and iron ore (Australia: 13,490km; Brazil: 11,086km) are imported from the main exporters.

Exporting steel products from Turkey to the U.S. East Coast involves long-distance trade (9,567km).

Competitiveness Analysis

Turkey is in the transition phase from an industrialising country to an industrialised country and is placed 63rd in the GCI of 2008/2009. While the Turkish economy is among the top fifteen economies in terms of domestic market size (rank 15) it is ranked 25th in terms of foreign market size. The quality of Turkey's overall (rank 70) and port infrastructure (rank 88) is below average by international standards.

No data are available about Turkish manufacturing wages and hourly compensation costs. However, it is likely that labour costs are lower in industrialising Turkey than in the industrialised United States.

Conclusion

The statistically significant seven-month long reduction of Turkish steel exports to the U.S. following a one-standard deviation oil price shock may be facilitated by very long upstream and long downstream trade distances and by Turkey's underdeveloped port infrastructure.

It seems that Turkey's international competitiveness in market size and low labour costs stop short of counterbalancing the negative impacts of the interplay between rising oil prices, very long trade distances and underdeveloped port infrastructure. Additionally, Turkish steel exports to the U.S. are analysed per steel export category in section 6.4.7.

6.2.7.4 United Arab Emirates

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to an increase of the United Arab Emirates' (UAE) steel exports to the U.S. which lasts for two months. The impulse response peak is reached two months after the shock at 62qmt. The impulse response values are statistically insignificant.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 12.7% of the volatility in the steel export variable. Therefore, the relative importance of the oil price variable for the steel export variable is moderate.

Granger Causality Analysis

There is Granger causality at the 1% level. The GC test result confirms the statistical usefulness or the predictive value of the oil price variable for the steel export variable.

Trade Distance Analysis

The UAE do not produce coking coal domestically. Therefore, the coking coal used for steel production needs to be imported. The UAE also imports iron ore for steel production (2008: 300tmt).

Importing coking coal from the main exporting countries involves very long distance trade (Australia: 13,736km; U.S. East Coast: 15,594km). Importing iron ore also involves long/very long distance trade if imports come from the largest iron ore exporters Australia (8,945km) or Brazil (15,636km).

Exporting steel products from the UAE to the U.S. East Coast also involves very long distance trade (15,316km).

Competitiveness Analysis

The UAE are industrialised and are placed 31st in the GCI of 2008/2009. While their domestic market size is rather average by international standards (rank 55), the UAE's foreign market size (rank 32) is above average. Moreover, the infrastructure of the UAE is very well developed (overall infrastructure: rank 11; port infrastructure: rank 8). No data are available about the UAE's manufacturing wages and hourly compensation costs.

Conclusion

Steel export volumes from the UAE to the U.S. increase for two months following a one-standard deviation shock in real oil prices. Very long upstream and downstream trade distances seem to be counterbalanced to a certain extent by the country's very good infrastructure and its overall competitiveness by international standards. Maybe other factors not included in the analysis are also at play. For example, the composition of steel exports may play are role. Due to the fact that the UAE are industrialised and internationally competitive, the steel product mix of the UAE may be dominated by high-value products. The relative share of transport costs to final selling prices for high-value steel products may be relatively lower than for low-value products thus making high-value products less vulnerable to rising transport costs.

6.2.7.5 Summary

Steel exports to the U.S. decrease in three of four Middle Eastern countries included in the analysis (Israel, Saudi Arabia, Turkey) following a one-standard deviation oil price shock while export figures from the UAE increase marginally.

The main reason for this trend may be long/very long upstream and downstream trade distances and steelmaking raw material scarcity. However, industrialised Israel and UAE are relatively less affected than industrialising Saudi Arabia and Turkey. While the impulse response estimates for Israel and the UAE are statistically insignificant, the downturn in Saudi Arabian and Turkish steel exports to the U.S. is statistically significant.

One reason for the ability of Israel and the UAE to absorb an oil price shock in connection with very long distance trade relatively better than Saudi Arabia and Turkey may be the composition of steel exports. The composition of export products may be dominated by high-value steel products which should be relatively less affected by rising transport costs than low-value steel products. On the other hand, a relatively high share of low-value steel products in Saudi Arabian and Turkish steel export portfolios might facilitate the reduction of steel exports to the United States.

Turkish steel exports to the U.S. seem to be significantly more affected than Saudi Arabian export volumes. One reason for this may be the superior Saudi infrastructure in comparison with Turkey (overall infrastructure: rank 38 vs. rank 70; port infrastructure: rank 45 vs. rank 88). However, additional factors may also play a role.

By and large, the findings for the Middle Eastern countries included in the analysis are in line with the hypothesis that oil price shocks or rising maritime fuel costs lead to a regionalisation of trade flows and to a reduction of trade distances in the global steel industry.

6.2.8 Asia

Section 6.2.8 analyses the econometric estimates for China (6.2.8.1), Hong Kong (6.2.8.2), India (6.2.8.3), Indonesia (6.2.8.4), Japan (6.2.8.5), Malaysia (6.2.8.6), the Philippines (6.2.8.7), Singapore (6.2.8.8), South Korea (6.2.8.9), Taiwan (6.2.8.10), and Thailand (6.2.8.11). Section 6.2.8.12 concludes.

Table 6.13 VEC Analysis - Asia

Country	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
China	1	-7,390.733 *	7.1	0.00
	2	-10,899.180 **		
	3	-3,989.527		
	4	-8,208.049 *		
	5	-7,856.081		
	6	-1,499.027		
Hong Kong	1	-456.020 *	5.7	0.42
	2	-108.687		
	3	-232.930		
	4	-7.064		
India	1	-3,396.760 *	12.0	0.23
	2	-1,602.996		
	3	-500.945		
Indonesia	1	-339.700	29.1	0.10
	2	-386.119		
	3	-654.063		

VEC Analysis - Asia (continued)				
Country	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
Japan	1	-752.057	28.8	0.37
Malaysia	1	5.821	12.4	0.02
Philippines	1	67.280	9.7	0.06
Singapore	1	183.126	3.3	0.06
South Korea	1	-1,752.367	9.0	0.12
	2	-764.120		
Taiwan	1	-1,988.936	8.6	0.57
	2	-1,071.379		
	3	-2,136.850		
	4	-3,918.874		
Thailand	1	-1,954.154	6.6	0.41
	2	-722.793		
	3	-1,113.020		
	4	-293.480		

Source:
Author's calculations (EViews®)

* statistically significant at 68% error bands
** statistically significant at 90% error bands
*** statistically significant at 95% error bands

6.2.8.1 China

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to a decrease of Chinese steel exports to the U.S. which lasts for six months. The impulse response peak is reached two months after the shock at -10,899qmt. The impulse response values for periods one (68% error bands), two (90% error bands), and four (68% error bands) are statistically significant.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 7.1% of the volatility in the steel export variable. Therefore, the relative importance of the oil price variable for the steel export variable is rather low.

Granger Causality Analysis

There is Granger causality at the 1% level. The GC test result confirms the statistical usefulness or the predictive value of the oil price variable for the steel export variable.

Trade Distance Analysis

Although China produces large volumes of coking coal domestically (2008: 353,086tst), it has become a very significant net importer of coking coal in recent years. While China imported 1Mt in 2005, net imports increased to 7Mt in 2008 and to 38Mt in 2011. The country will become the largest importer of coking coal in the foreseeable future. China is already the largest importer of iron ore. In addition to its domestic production (2008: 1,190,011tmt), China's net imports amounted to 444,018tmt in 2008 with tendency to rise.

Importing coking coal from one of the main exporting countries involves long-distance trade if imports come from Australia (8,721km) and very long distance trade if imports come from the U.S. South Coast (19,626km). Importing iron ore from one of the largest exporting countries involves long distance trade if imports come from Australia (6,354km) and very long-distance trade if imports come from Brazil (21,061km). Although the distance of trade between Australia and China is significantly smaller than between Brazil and China, the Chinese Republic also needs to import vast amounts of iron ore from Brazil to cover its enormous demand for iron ore imports.

Exporting steel products from China to the U.S. involves very long trade distances (U.S. East Coast: 11,280km).

Competitiveness Analysis

In 2008, China was in the transition phase from a developing to an industrialising country. The country is placed 30th in the GCI of 2008/2009. China has a considerable advantage in terms of market size (domestic: rank 2; foreign: rank 1). The quality of the country's infrastructure, however, is only average by international standards (overall infrastructure: rank 58; port infrastructure: rank 54).

China has a very significant comparative advantage over the U.S. in manufacturing wages ($1.06 vs. $21.50). No data are available for Chinese hourly compensation costs. Chinese hourly compensation costs are expected to be significantly lower than U.S. compensation costs.

Conclusion

The statistically significant six-month reduction of Chinese steel exports to the U.S. following a one-standard deviation oil price shock may be facilitated by long/very long upstream (coking coal, iron ore) and very long downstream trade distances (steel). The Chinese infrastructure, which is rather average by international standards, is unlikely to contribute significantly to a reduction of the impact of rising oil prices.

It seems that low labour costs and China's market size cannot counterbalance the combination of an oil price shock and very large trade distances, especially when, as can be expected for China, steel exports are dominated by low-value steel products which are more vulnerable to high transport cost levels than high-value products. The excursus below provides more insight into the reasons behind declining steel exports to the United States. Additionally, Chinese steel exports to the U.S. are analysed per steel export category in section 6.4.8.1.

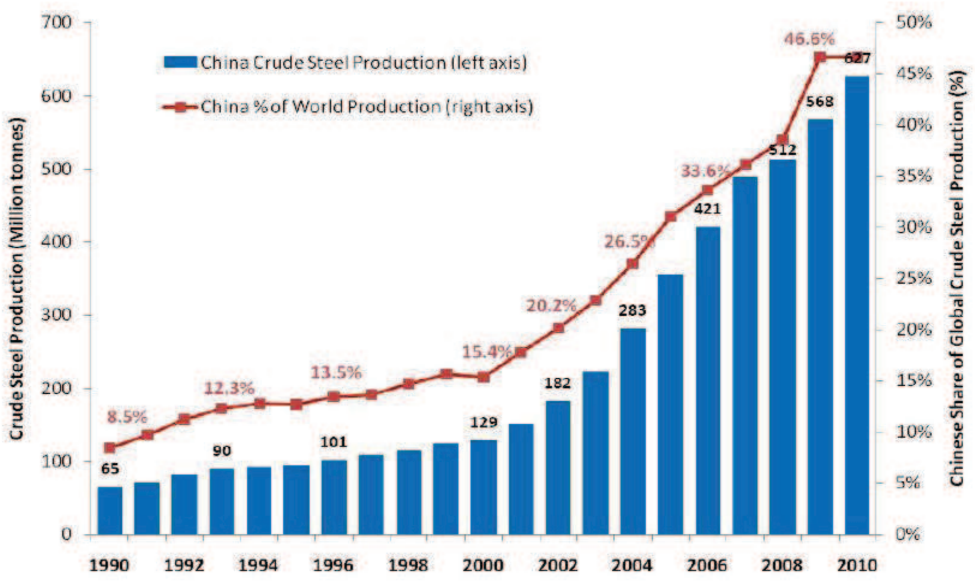
Excursus: U.S. Steel Industry vs. Chinese Steel Industry

The U.S. and the Chinese steel industries are compared below to gain additional insight into the reasons for the statistically significant decline of Chinese steel exports to the U.S. following a shock in real oil prices (see 6.2.8.1, 6.4.8.1).

U.S. and Chinese Steel Production and Exports

China became the world's largest steel producer in 1996 when production exceeded 100Mt for the first time. As can be seen in figure 6.1, Chinese steel output has continued to rise rapidly since then. The average annual growth rate of Chinese steel production was 18.5% between 2000 and 2009 and steel production reached 627Mt by 2010 which is equivalent to a relative share of 46.6% of world production.

Figure 6.1 China's Crude Steel Production and Share of Global Production

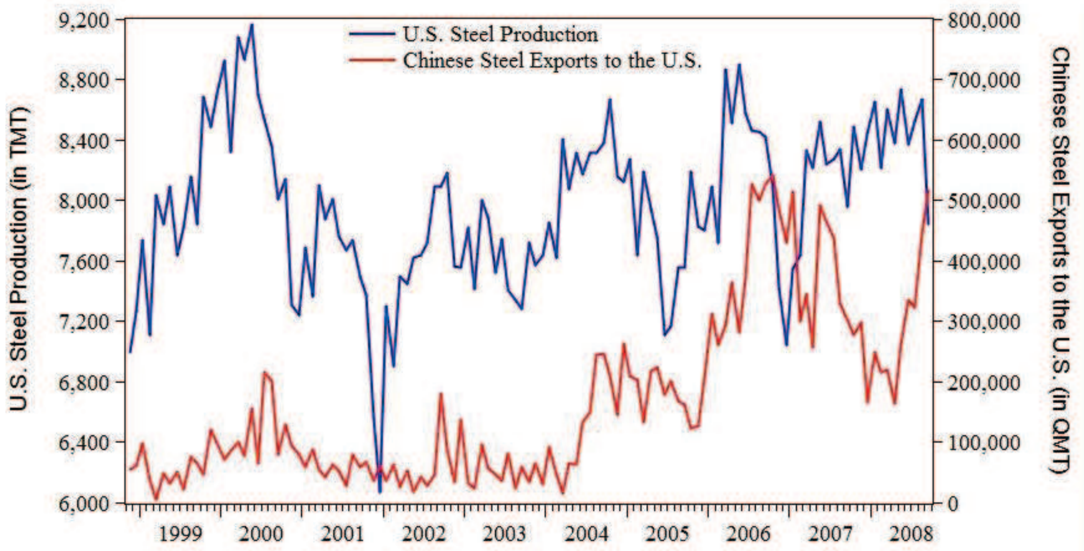


Source: World Steel Association 2011, cited by Hasanbeigi et al. 2011

In 2006, China also became the largest steel exporting country with exports of 49Mt (an increase of 91% over 2005), an export rate of almost 1Mt per week. In 2008, about 10% of Chinese steel production was exported. While Chinese steel production continues to expand, U.S. steel production reached its peak in 1973 at 137Mt, fell below 100Mt in 2000 and stood at 98Mt in 2006 (Hasanbeigi et al. 2011; Price et al. 2001; WCI n.d.a; Zhang and Wang 2010).

Figure 6.2 shows the development of U.S. crude steel production and Chinese steel exports to the U.S. during the sample period. Chinese steel exports to the U.S. increase significantly between mid-2004 and early-2007 but then start to decline considerably.

Figure 6.2 U.S. Domestic Steel Production and Chinese Steel Exports to the U.S.



Source: Author's illustration (EViews®), data: U.S. Census 2010a; World Steel Association 2010

Table 6.14 shows the relative change of Chinese steel exports to the U.S. for the first three quarters of 2007/2008 on a year-over-year basis. In total, exports fall by 20.8% or one-fifth.

Table 6.14 Chinese Steel Exports (in QMT) and U.S. Real GDP (in US$)

Chinese Steel Exports to the U.S.				U.S. Real GDP		
	2007	2008	percentage change	2007	2008	percentage change
January	515,188	247,663	-51.9%	13,057	13,278	+1.7%
February	299,714	214,676	-28.4%	13,035	13,256	+1.6%
March	345,120	220,440	-36.1%	13,080	13,266	+1.4%
April	257,230	163,873	-36.3%	13,136	13,298	+1.2%
May	490,876	261,950	-46.6%	13,174	13,311	+1.0%
June	464,104	334,487	-27.9%	13,211	13,321	+0.8%
July	438,974	322,481	-26.5%	13,244	13,296	+0.4%
August	329,863	447,406	+35.6%	13,271	13,193	-0.6%
September	302,984	515,664	+70.2%	13,295	13,072	-1.7%
Total	3,444,053	2,728,640	-20.8%	118,500	119,291	+1.2%

Source: U.S. Census 2010a, E-forecasting 2012, Author's calculations

Declining U.S. GDP growth rates are a logical candidate for explaining declining Chinese export volumes. Table 6.14 shows declining monthly growth rates on a year-over-year basis as the U.S. slowly plunges into recession due to the on-going mortgage crisis.

At the same time, it is noteworthy that U.S. domestic steel production increases beginning in early 2007 parallel to declining import volumes from China (see figure 6.2). The increase of U.S. steel production on a year-over-year basis can clearly be seen in table 6.15 as U.S. steel production increases by 4% during the first three quarters. Moreover, for the first three quarters of 2008 Canadian steel exports to the U.S. were up 21.3% and Mexican steel exports to the U.S. were up 6.8% on a year-over–year basis (see table 6.16). This indicates that factors other than declining U.S. growth rates also played a role in the Chinese export decline.

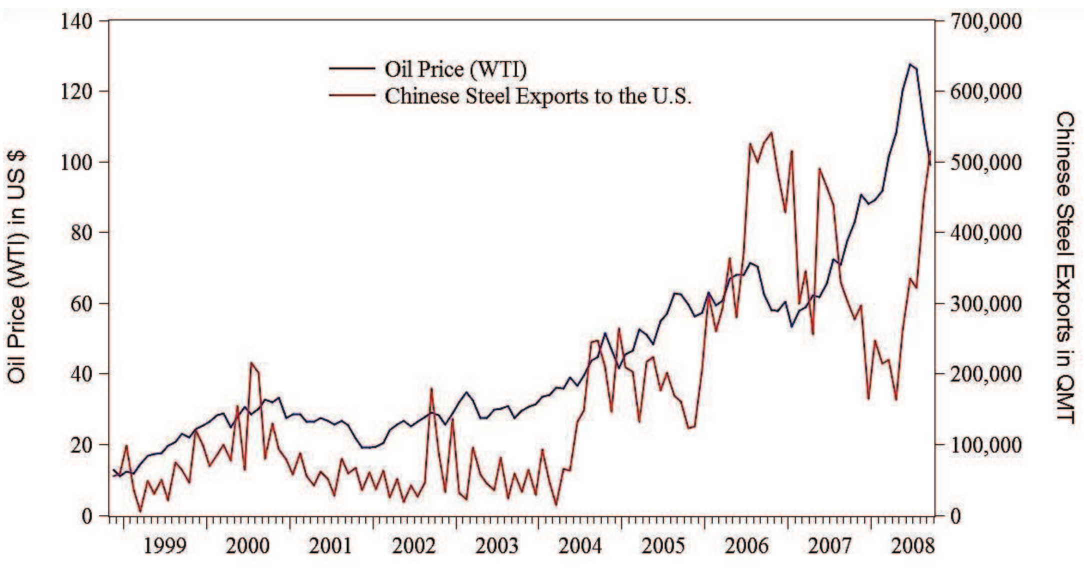
Table 6.15 U.S. Steel Production (in TMT)

	2007	2008	percentage change
January	7,543	8,652	+14.7%
February	7,634	8,215	+7.6%
March	8,327	8,598	+3.3%
April	8,214	8,376	+2.0%
May	8,521	8,733	+2.5%
June	8,240	8,373	+1.6%
July	8,274	8,517	+2.9%
August	8,336	8,668	+4.0%
September	7,960	7,842	-1.5%
Total	73,049	75,974	+4.0%

Source: World Steel Associaton 2010

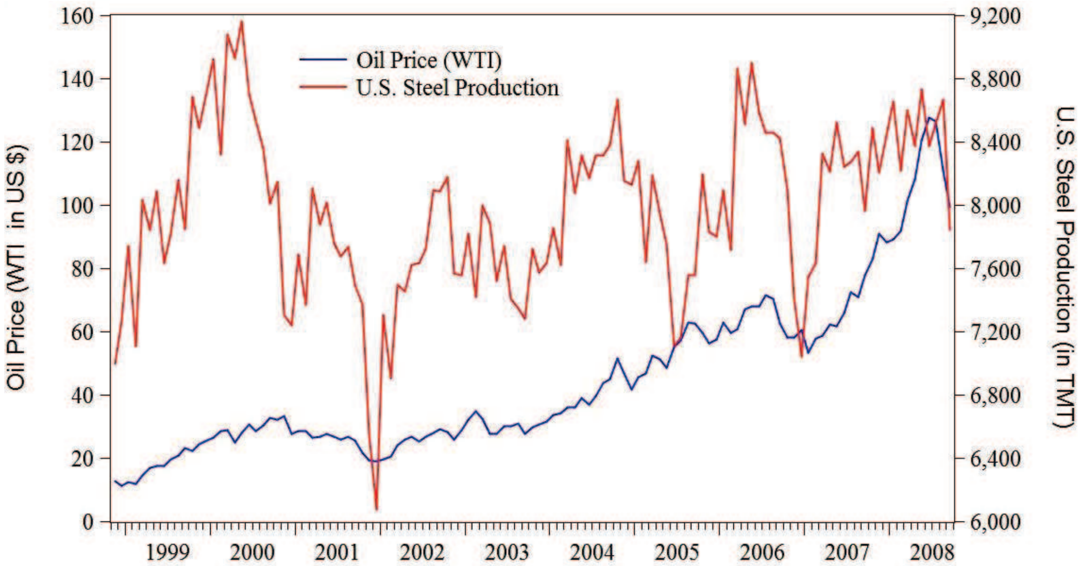
In this context, increasing oil prices combined with long-distance trade between China and the U.S. are a logical candidate. Figure 6.3 and figure 6.4 clearly show that decreasing Chinese steel exports to the U.S. and increasing U.S. domestic steel production between early 2007 and the third quarter of 2008 coincide with rising oil prices. There seems to be a shift in Chinese export and U.S. production volumes as average oil prices rise above $60.

Figure 6.3 Oil Price (WTI) and Chinese Steel Exports



Source: Authors illustration (EViews®), data: EIA 2011c, n.d.b; U.S. Census 2010a

Figure 6.4 Oil Price (WTI) and U.S. Steel Production



Source: Author's illustration, data: EIA 2011c, n.d.b, World Steel Associaton 2010

Table 6.16 Canadian and Mexican Steel Exports to the U.S. (in QMT)

Canadian Steel Exports to the U.S.				Mexican Steel Exports to the U.S.		
	2007	2008	percentage change	2007	2008	percentage change
January	473,731	669,422	+41.3%	301,958	278,115	-7.9%
February	440,677	607,619	+37.9%	220,286	290,863	+32.0%
March	575,194	658,467	+14.5%	194,326	289,838	+49.1%
April	534,761	705,445	+31.9%	319,753	278,552	-12.9%
May	526,310	630,408	+19.8%	188,756	268,428	+42.2%
June	505,322	609,755	+20.7%	240,323	235,793	-1.9%
July	496,880	596,238	+20.0%	295,904	249,972	-15.5%
August	452,400	440,736	-2.6%	219,623	225,170	+2.5%
September	459,355	498,180	+8.5%	201,176	213,338	+6.0%
Total	4,464,630	5,416,270	+21.3%	2,182,105	2,330,069	+6.8%

Source: U.S. Census 2010a, Author's calculations

Additional Factors

There are factors other than oil prices, trade distance, and competitiveness (see section 6.2.8.1) that might also have contributed to declining steel exports from China to the U.S. and increasing U.S. domestic steel production. These determinants are described below.

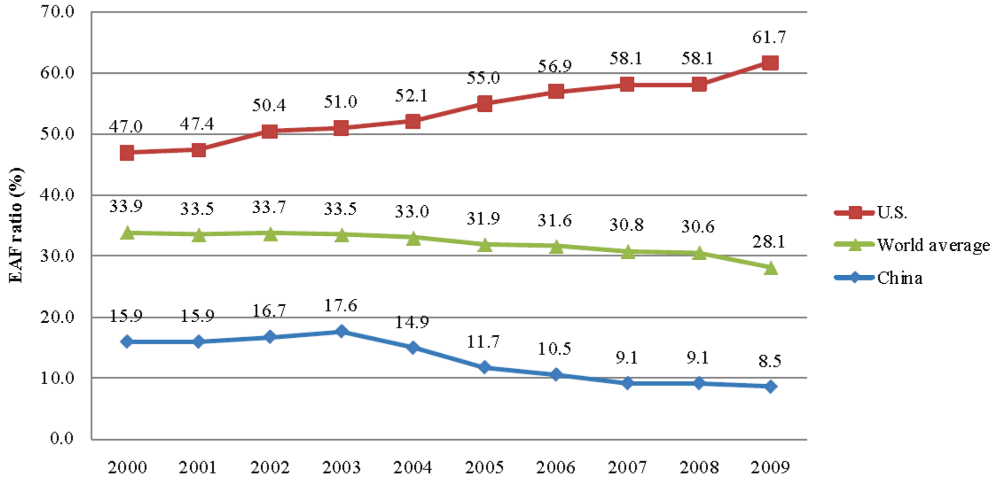
Energy Intensity of Steel Industries

Steel production is very energy intensive. Since energy makes up a significant share of steel production costs (20%-40% depending on the country where steel is produced), a reduction of energy intensity and subsequently reduced production costs improve the competitiveness of steel industries (World Steel Association 2008).

Data compiled by the American Iron and Steel Institute (AISI) indicate that the energy intensity of the U.S. steel industry declined by 28% from 16.4 MBtu/ton to 11.8 MBtu/ton between 1990 and 2004 and by 15% between 2002 and 2006 (AISI 2008; EPA 2007). Although the energy intensity of Chinese steel production also declined considerably since the 1990s (Hasanbeigi et al. 2011), a study by the IEA (2010) finds that in 2007, the energy intensity of U.S. steel production was on average 3.7 GJ/ton below the energy intensity of Chinese steel production. The most comprehensive study directly comparing the energy intensity of the U.S. and Chinese steel industries in 2006 has been published by Hasanbeigi et al. (2011). The authors define energy intensity as energy use per unit of steel produced. They find that in 2006, the energy intensity of the U.S. steel industry (14.90 GJ/t) was 36% or one-third below the energy intensity of the Chinese steel industry (23.11 GJ/t). The following aspects explain the difference between both industries in terms of energy intensity:

- *Structure of Steel Manufacturing Sectors*: There are two main steel production processes, primary steel production or basic oxygen furnace (BOF) and secondary steel production or electric arc furnace (EAF). The latter production process is significantly less energy intensive than the former production process. U.S. steel industry data from 2004 indicate that BOF steelmaking requires 18.99 MBtu/ton while EAF steelmaking requires only 5.01 MBtu/ton (EPA 2007; Price et al. 2001; WCA n.d.d; WCI n.d.a). While the relative share of energy efficient EAF steelmaking in the U.S. steel industry increased from 47% in 2000 to 58.1% in 2008 (the last year of the sample period), the relative share in the Chinese steel industry declined from 15.9% in 2000 to 9.1% in 2008. Figure 6.5 shows that the relative share of U.S. EAF production is significantly above the world average (2008: 30.6%), whereas the relative share of Chinese EAF production is well below average (Hasanbeigi et al. 2011).
- *Fuel Shares*: Relative fuel shares also have an impact on the production cost structure of steel industries. For example, natural gas, which is comparatively cheap in the U.S., has a relative share of 34.5% in the U.S. steel industry`s energy use, while the relative share of the Chinese steel industry is only 0.45% (Hasanbeigi et al. 2011).

Figure 6.5 Share of EAF in Total Steel Production in China and the U.S. and World Average Values



Source: World Steel Association 2009, cited by Hasanbeigi et al. 2011

- *Product Mix*: The respective steel product mix is another key variable for the energy intensity of steel industries because of varying energy requirements in the rolling/casting/finishing processes. Differences in the product mix of both steel industries may therefore also play a role in the energy intensity gap (Hasanbeigi et al. 2011).
- *Scale of equipment*: The average capacity of steel production plants also plays a role for the energy intensity of production sites. For example, the average capacity of American blast furnaces is bigger than the average capacity of Chinese blast furnaces. Large blast furnaces are by tendency less energy intensive than small furnaces (Hasanbeigi et al. 2011).
- *Sector Penetration of Energy-Efficient Technologies*: Developing countries often use outdated technology for steel production (Price et al. 2001; World Steel Association 2008). Although China gradually replaces outdated technology, it can be assumed that the penetration of energy-efficient technologies in the U.S. steel industry is stronger when compared with the Chinese steel industry (Hasanbeigi et al. 2011).
- *Energy-Related Subsidies*: Many developing countries, among them China, use energy-related subsidies to increase the competitiveness of energy-intensive industries, thereby ensuring energy-access below the cost of supply. In 2005, China spent $25 billion for energy-subsidies. These subsidies are an incentive to waste energy and to increase energy consumption (Pellényi et al. 2008). Tang et al. (2010) find that the improvement of energy-efficiency in China slowed down between 2002 and 2007, especially in the industrial sector. They attribute the decline to a lack of incentives to reduce energy consumption and indicate that the surge in Chinese steel

production in previous years is to a significant extent due to energy-related subsidies because they have led to a competitive advantage. The authors conclude that the policy of generating economic growth via energy subsidies is not sustainable and manageable in the long run.

Steelmaking Raw Materials

One of the main challenges faced by the global steel industry revolves around the availability of raw materials (OECD 2012). Therefore, steelmaking raw material abundance is a significant comparative advantage for a country's steel industry while net importers face a comparative disadvantage, especially at high oil prices due to rising upstream transport costs (Pellényi et al. 2008; World Steel Association 2008). For instance, Beverelli (2010) finds that a 10% increase in oil prices leads to an increase of iron ore freight rates between 8.9% and 10.5% (see section 2.3). The main raw materials used in the steel production process are listed in table 6.1.

The U.S. is a net exporter of the two main steelmaking raw materials coking coal[85] and iron ore while China has become a net importer of both raw materials in recent years[86] with tendency to rise. The tendency can be clearly seen for the example of coking coal (see table 6.17).

Table 6.17 Chinese Coking Coal Net Imports (in Mt)

2005	2006	2007	2008	2009	2010	2011
1	5	3	7	n.a.	n.a.	35

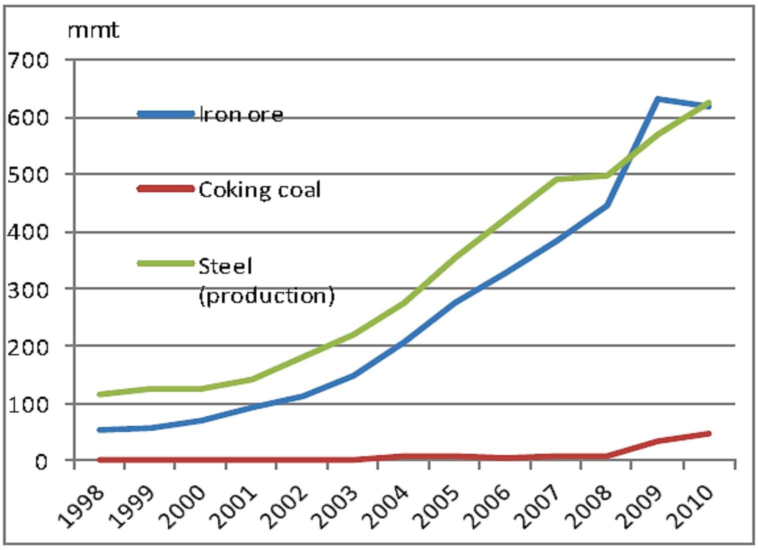
Source: Author's calculations; data see tables 6.2 and 6.3

Moreover, China is by far the largest iron ore producer worldwide. Nonetheless, China has become a net importer of iron ore in the mid-1990s and already accounted for 58.8% of global iron ore imports in 2010 with tendency to rise (see figure 6.6).

In 2011, Chinese iron ore imports were up 11% and already accounted for 61.4% of total imports followed by Europe (11.9%), Japan (11.5%), South Korea (5.8%), and Taiwan (1.8%). This is due to the fact that China is the world's largest steel producer (98% of the iron ore produced is used for steelmaking) and that the average iron ore content of the ore mined in China is rather low (OECD. 2012).

Chinese iron ore imports mainly come from Australia, Brazil and India while coking coal is mainly imported from Australia but also from the United States.

Figure 6.6 Chinese Imports (Iron Ore, Coking Coal) and Steel Production



Source:OECD 2011

While China is resource abundant in terms of silicon, tin, molybdenum and tungsten, it needs to import significant volumes of steel scrap from the U.S., manganese from South Africa, Australia, Gabon and Brazil, chromium from South Africa, Turkey, Kazakhstan and India, nickel from Indonesia and the Philippines, and zinc from South America and Australia for steel production which creates large upstream trade costs at high oil prices.

Besides iron ore and coking coal, the U.S. is also self-sufficient in terms of vanadium, zinc, molybdenum, and tungsten while chromium is imported for steel production from neighbouring Canada. Silicon also needs to be imported (OECD 2012). Summing up, the U.S. steel industry has a comparative advantage over the Chinese steel industry in terms of steelmaking raw material abundance[87].

Between January 2007 and August 2008, the price of U.S. imports from China rose by 7% in a sharp departure from earlier trends. In order to understand the forces behind the increase, Amiti and Davis (2009) construct an import index for the time period between December 2003 and August 2008, and use highly disaggregated data to track price movements for different product types. Between late 2003 and the end of 2006, the price index falls from 100 to 97 but then rises to 103.8 between early 2007 and August 2008, an increase of 6.8%. In 2007, consumer and capital goods accounted for 85% of U.S. imports from China while industrial supplies such as steel accounted for 15%. Amiti and Davis analyse the trends in import prices for the end-use categories and find that the largest increases in U.S. import prices occurred in the industrial supplies category while the increases in consumer and capital import prices were rather modest. The authors also find that the price increase in the industrial supplies category is mainly due to rising prices for intermediate inputs and commodities such as iron ore and coking coal. The reasons for the price increase of (steelmaking) raw materials may be a combination of increasing mining costs, increasing transport costs, and increasing demand. Amiti and Davis conclude that rising commodity input prices were the main factor behind the price increase of U.S. imports from China while shifts in exchange rates (appreciation of the Chinese Renminbi against the U.S. Dollar) and rising Chinese wages only played a minor role.

China's dependence on the import of steelmaking raw materials is expected to increase, albeit at a slower pace than in recent years. Parallely, China increasingly relies on restrictions for steelmaking raw materials to direct domestic supply to its steel industry in order to reduce steelmaking production costs. For example, China imposes export duties on iron ore (tariff rate: 10%), coke (40%) and coking coal (10%), steel scrap (40%), manganese (15%), zinc (30%), tin (20%), molybdenum (15%), and tungsten (20%) to protect its interests. Moreover, China imposes quantitative export restrictions or export quota on coke, coking coal, manganese, zinc, tin, molybdenum, and tungsten. The U.S., on the other hand, does not impose any export restraints on steelmaking raw materials due to a constitutional prohibition on the use of export duties (OECD 2012).

Tang et al. (2010) argue that it will be increasingly difficult and impractical for China to control raw material prices as a result of increasing import dependence.

Directional Trade Imbalances

Trade balances are an essential determinant of maritime transport costs (Kumar and Hoffmann 2002: 42; Wilsmeier and Martinez-Zarzoso 2010). Directional trade imbalances can significantly increase transport costs (Clark et al. 2002). Large bilateral trade imbalances between countries cause vessels to run fully loaded on the outward trip but at a fraction of total capacity on the return voyage (Hummels 2009). Therefore, minimising empty nonrevenue miles and days is key (Bardi et al. 2006: 248) because directional trade imbalances reduce the possibility to split fixed costs over two journeys (Behar and Venables 2010). A balanced load eliminates the empty backhaul costs a vessel must account for in the initial loaded move and enables the vessel to spread a round-trip's costs over two commodity moves instead of one (Bardi et al. 2006: 404).

Bulk flows are, however, dominantly directional (inward or outward) (Rodrigue and Browne 2008: 159) instead of bi-directional (inward and outward). This actually means that the variable costs (including fuel costs) for the return of a bulk carrier transporting iron ore, coking coal or steel need to be included into the fuel bill in many cases.

For instance, a significant imbalance exists between Asian-U.S. and U.S.-Asian trade. In 2007, Asia-United States cargo flows exceeded those in the reverse direction by 10.5 million TEUs up from 10.3 million TEUs in 2006 and 8 million TEUs in 2005 (UNCTAD 2008). Therefore, the cost of shipping from Asia has risen sharply in recent years relative to the costs of shipping to Asia (Golub and Tomasik 2008). Excess of supply means that Asian exporters regularly end up paying more than 50% of extra charge in transportation costs compared to suppliers in the United States (Clark et al. 2002).

Restructuring of U.S. Steel Industry

In the early 2000s, the U.S. steel industry was in a state of crisis with 65,000 jobs lost between 1991 and 2001 (Ikenson 2006; Merkel and Lovik 2003). In March 2002, the Bush Administration reacted and announced temporary safeguards to protect the U.S. steel industry from import competition (The White House 2002). However, the punitive tariffs of up to 30% were lifted in December 2003 (The White House 2003) to avert a looming trade war (Tran 2003).

All in all, subsidising and protectionism of the U.S. steel industry, which dates back until the 1960s, could not prevent its decline until the early 2000s. As a result of protection, the industry suffered from overcapacity because bankruptcies or market exits of unprofitable steel companies were prevented artificially (Ikenson 2002; Merkel and Lovik 2003).

However, since the early 2000s the industry has gone through a process of restructuring and consolidation (EPA 2007; Price et al. 2001) which Ikenson (2006: 1) describes as follows: “What was, as recently as 2002, a fragmented, perennially money-losing, capital-starved industry that relied on government for subsidised loans, protection from creditors, and insulation from foreign competition has become one of America’s strongest, most profitable, and most promising manufacturing industries.”

Due to the high fixed cost nature of steel production, steel producing companies have to sell large volumes of steel to cover fixed costs and even larger sales are necessary to achieve profitability. For instance, in 2000, 27 producers of hot-rolled steel operated 35 mills with a total production capacity of 81 million metric tons. In 2006, the remaining 14 producers operated 29 mills with a total capacity of 73mt. Parallel to a decline in overall capacity, capacity per firm increased by 69% and the number of the mills per company increased by 63%. The concentration of production is also evident in view of market shares. While the top three U.S. producers of hot-rolled steel had a home market share of 36% in 2000, the market share of the top three companies was 61% in 2005. Similar trends have also occurred for the top three producers of cold-rolled steel (market share in 2000: 47%; 2005: 70%), rebar (2000: 45%; 2005: 80%), and tin plate (2000: 60%; 2005: 100%). There are similar patterns for every major steel product category (Ikenson 2006).

Increased market concentration facilitates economies of scale as fixed costs or the average unit cost of production decrease. Moreover, it is easier for companies to control output in accordance with changes in demand (Ikenson 2002). Declining fixed costs, strengthened financial viability, increasing labour productivity and the industries return to profitability (average operating profits of 10.3% between 2004 and 2006 up from 0.1% between 2000 and

2003) led to an increase of the Dow Jones Steel Stock Index of 400% between December 2002 and November 2006 (EPA 2007; Ikenson 2006). Additionally, the strong increase of EAF production also played a vital role in the resurgence of the American steel industry (Ikenson 2002) As Ikenson (2006: 2) puts it, “in the span of just a few years, everything has changed for the U.S. steel industry.”
On the contrary, although the Chinese steel industry already included 85 key medium and large sized enterprises in 2006 with a total crude steel production of 349Mt (Hasanbeigi et al. 2011), until recently it remains comparatively fragmented (OECD 2012).

Labour Costs

China has a comparative advantage over the U.S. in terms of labour costs. However, wage costs increased at an average of 14% in previous years. While U.S. wages were forty-fold above Chinese wages in 1995, they are actually only eight-fold above Chinese wages (Stocker 2013b). While the industrialisation process is likely to further increase labour costs in the nearer future, demographics may also increasingly play a role in the development of Chinese wages. The Chinese statistical office recently announced that in 2012 the number of the population of working age declined for the first time by 3.45 million from 69.8% to 69.2% of the total population. This trend will become stronger between 2015 and 2020 and is likely to keep upward pressure on Chinese wages (Stocker 2013a). In addition to rising oil prices/transport costs, rising Chinese labour costs may further decrease or even reverse the total cost advantage Chinese steel producers have over U.S. steel producers. According to Rubin and Tal (2008), in 2008 U.S. steel producers already had a slim temporary advantage in the average cost of producing and shipping a ton of hot-rolled steel sheet over Chinese producers.

China’s Role in Global Production Networks and the Chinese Steel Industry

The Chinese economy has benefitted significantly from the vertical specialisation process in which multinational companies slice up their value chains and offshore labour-intensive production steps to low wage countries (Ma and Van Assche 2011). China has endorsed this trend by setting up an export-promotion program in the mid-1980s where companies are granted duty exemptions on imported raw materials and other inputs when they are solely used for export purposes. Amongst others, many companies from industrialised East Asian countries have taken advantage of the program and sliced up their value chains so that labour-intensive production steps are undertaken in China before the finished products are exported to Western countries (Ma and Van Assche 2009, 2010; Ma et al. 2009), a phenomenon that has become known as the East Asian Trade Model.

When it comes to the extent of vertical specialisation in the Chinese steel industry, the value of imported inputs in the value of exports for the steel processing industry was 59% in 1997 and already 69% in 2002 (Dean et al. 2007). A recent OECD study (2012: 36) also refers to the "large share that intermediate inputs account for in steel industry output." However, with about one hour and a half of labour time per ton of steel produced, steel production is not particularly labour intensive (Rubin and Tal 2008) which somewhat limits China's comparative labour cost advantage over the U.S. steel industry.

As can be seen in table 6.18, the relative share of Chinese processing imports (intermediate products, raw materials) from East Asia has increased from 68.8% in 1997 to 76.1% in 2007. At the same time, the relative share of processing imports from geographically distant non-Asian OECD countries (1997: 23.8%; 2007: 18.1%) and the rest of the world (1997: 7.3%; 2007: 5.8%) has declined.

Table 6.18 Share of China's Processing Imports by Country of Origin, 2007 (in %)

	Adjusted for Hong Kong Transshipments			Unadjusted
	1997	2002	2007	2007
East Asia	**68.8**	**73.3**	**76.1**	**86.6**
Hong Kong	-	-	-	47.1
Japan	26.9	26.5	23.7	10.6
South Korea	15.0	14.1	15.7	10.8
Singapore	3.2	3.4	4.3	2.9
Taiwan	16.9	19.0	20.3	9.6
Malaysia	2.2	3.9	4.5	1.5
Thailand	2.0	2.8	2.8	1.3
Philippines	0.2	1.7	3.5	2.1
Vietnam	0.2	0.1	0.2	0.1
Indonesia	1.8	1.3	0.9	0.4
Macau	0.4	0.6	0.3	0.2
Non-Asian OECD	**23.8**	**21.8**	**18.1**	**9.3**
United States	10.4	9.1	7.7	3.9
EU - 19	9.0	9.8	7.9	4.1
Canada	0.7	0.5	0.8	0.5
Australia	2.7	1.3	0.8	0.4
Other OECD	1.0	1.1	1.0	0.4
Rest of the World	**7.3**	**4.9**	**5.8**	**4.1**

Source: Ma and Van Assche 2011: 132

However, contrary to other industries, the Chinese steel industry increasingly needs to source from geographically distant countries so that longer upstream trade distances are involved than for most other industries. Therefore, the strategy of sourcing inputs from nearby countries before using them to manufacture products which are exported to geographically distant locations does not apply for the Chinese steel industry. In this context Ma and Van Assche (2011) find that the longer the import distance of inputs, the less attractive China becomes for long-distance exports of processed products as upstream and downstream trade and/or transport costs add up.

Ma et al. (2009; 2010) find that Chinese processing export volumes are negatively affected by increasing import and export distance. Due to the fact that processing exports make up a significant share of Chinese steel exports, upstream as well as downstream trade costs for steel exports to the U.S. may have an adverse effect on export volumes when oil prices are high. For China Ma et al. estimate an average import distance for intermediate products/raw materials of 3,283 miles or 5,283km. The calculated distance for the imports of coking coal (imports from Australia: 8,721km; U.S. Gulf Coast: 19,626km) and iron ore (Australia: 6,354km; Brazil: 21,061km) are therefore significantly above average. The calculated downstream trade distance for steel exports to the U.S. West Coast (11,280km) is also significantly above the average export distance for Chinese processing exports of 3,854 miles or 6,202km.

Conclusion

The in-depth analysis of the development of Chinese steel exports to the and U.S. domestic steel production during the sample period, the differences in terms of energy-efficiency between the Chinese and the U.S. steel industry, the different structure of both steel industries, the development of labour costs in China and the United States, and the role of China and its steel industry in global production networks provide further insight into the underlying factors of the reduction of Chinese steel exports to the U.S. following a shock in real oil prices described in sections 6.2.8.1 and 6.4.8.1.

6.2.8.2 Hong Kong

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to a decrease of Hong Kong's steel exports to the U.S. which lasts for four months. The impulse response peak is reached one month after the shock at -456qmt. The impulse value for period one is statistically significant at 68% error bands.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 5.7% of the volatility in the steel export variable. Therefore, the relative importance of the oil price variable for the steel export variable is rather low.

Granger Causality Analysis

There is no Granger causality for the whole model at the 1%, 5% or 10% level.

Trade Distance Analysis

Hong Kong does not produce coking coal domestically. Therefore, the coking coal used for steel production needs to be imported. No information is available about Hong Kong's iron ore production, imports, or exports.

Until the early 2000s, Hong Kong could import coking coal from nearby China. However, China has become one of the largest net importers of coking coal in recent years. Therefore, Hong Kong increasingly needs to source from more distant locations. The same applies for possible iron ore imports.

Importing coking coal from the main exporting countries involves long/very long distance trade (Australia: 8,601km; U.S. South Coast: 19,626km). While importing iron ore only involves a moderate trade distance when imports come from Australia (5,410km), the trade distance with Brazil (21,061km) is very long.

Exporting steel products from Hong Kong to the U.S. West Coast also involves very long distance trade (12,534km).

Competitiveness Analysis

Hong Kong is an industrialised country placed 11th in the GCI of 2008/2009. Hong Kong's economy profits from the country's excellent overall (rank 8) and port infrastructure (rank 2) and its foreign market size (rank 7). Its domestic market size is significantly smaller (rank 38). No data are available for Hong Kong's manufacturing wages and hourly compensation costs.

Conclusion

The partially statistically significant reduction of Hong Kong's steel exports to the U.S. following a one-standard deviation oil price shock is facilitated by significant upstream and downstream trade distances.

Hong Kong's strong overall competitiveness and its excellent infrastructure might help to reduce the impact of oil price shocks.

6.2.8.3 India

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to a reduction of Indian steel exports to the U.S. which lasts for three months. The impulse response peak is reached one month after the shock at -3,397qmt. The impulse response value for period one is statistically significant at 68% error bands.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 12% of the volatility in the steel export variable. Therefore, the relative importance of the oil price variable for the steel export variable is moderate.

Granger Causality Analysis

There is no Granger causality at the 1%, 5% or 10% level.

Trade Distance Analysis

India produces coking coal domestically (2008: 13,910tst). However, the country needs to import vast amounts of coking coal (2008: 29Mt) to cover demand. On the other hand, India is one of the largest net exporters of iron ore (2008: 100,800tmt).

Importing coking coal from the main exporting countries involves very long distance trade (Australia: 11,866km; U.S. East Coast: 15,888km). Exporting steel products from India to the U.S. East Coast also involves very long distance trade (15,516km).

Competitiveness Analysis

India is a developing country placed 50th in the GCI of 2008/2009. While the country is very competitive in terms of domestic (rank 4) and foreign market size (rank 5), its infrastructure is underdeveloped (overall infrastructure: rank 90; port infrastructure: rank 93).

India has a very significant comparative advantage over the U.S. in manufacturing wages ($1.17 vs. $21.50). No data are available for Indian hourly compensation costs. However, Indian compensation costs are also likely to be significantly lower than U.S. compensation costs.

Conclusion

The partially statistically significant three-month reduction of Indian steel exports to the U.S. following a one-standard deviation oil price shock may be facilitated by very long upstream (coking coal) and downstream trade distances (steel) and India’s underdeveloped infrastructure.

It seems that iron ore abundance, low labour costs and India’s huge market size cannot completely counterbalance the impact of an oil price shock in combination with very long trade distances and underdeveloped infrastructure.

6.2.8.4 Indonesia

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to a reduction of Indonesian steel exports to the U.S. which lasts for three months. The impulse response peak is reached three months after the shock at -654 qmt. The impulse values are statistically insignificant.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 29.1% of the volatility in the steel export variable. Therefore, the relative importance of the oil price variable for the steel export variable is large.

Granger Causality Analysis

There is no Granger causality at the 1%, 5% or 10% level. However, the p-value (0.103) for the Granger causality test is nearly statistically significant at the 10% level.

Trade Distance Analysis

In 2008, Indonesia was one of the largest coking coal exporters (30Mt) and a net importer of iron ore (2008: 1,300tmt). Importing iron ore from Australia (2,730km) involves short-distance trade. Resource-abundance in terms of coking coal and short-distance trade for iron ore imports puts Indonesia in a good position in view of steelmaking raw material availability.

Exporting steel products from Indonesia to the U.S. West Coast involves very long distance trade (15,516km).

Competitiveness Analysis

Indonesia is a developing country placed 55th in the GCI of 2008/2009. While the country is quite competitive in terms of domestic (rank 16) and foreign market size (rank 24), its overall infrastructure (rank 96) and its port infrastructure (rank 104) are underdeveloped.

No data are available for Indonesian labour costs. However, it can be expected that developing Indonesia has a labour cost advantage over the industrialised United States.

Conclusion

The reduction of Indonesian steel exports to the U.S. following a one-standard deviation oil price shock lasts for three months and may be fostered very long downstream trade distances and Indonesia’s significantly underdeveloped infrastructure.

It seems that coking coal abundance, short trade distances for iron ore imports, low labour costs and significant market size reduce the impact of an oil price shock so that the reduction of steel exports to the U.S. remains statistically insignificant.

6.2.8.5 Japan

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to a reduction of Japanese steel exports to the U.S. which lasts for one month (-752qmt). The impulse response value is statistically insignificant.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price contributes about 28.8% of the volatility in the steel export variable which indicates that the relative importance of the oil price variable for the steel export variable is large.

Granger Causality Analysis

There is no Granger causality at the 1%, 5% or 10% level.

Trade Distance Analysis

Although Japan produces coking coal domestically (2008: 40,290tst), it is one of the largest importers of coking coal (2008: 58Mt). Japan is also a net importer of iron ore (2008: 140,351tmt).

Importing coking coal from the two largest exporting countries involves long-distance trade in case of Australia (8,236km) and very long distance trade in case of the U.S. (Gulf Coast: 17,872km). Importing iron ore from the main exporting countries also involves long/very long distance trade (Australia: 7,119km; Brazil: 22,494km). Exporting Japanese steel to the U.S. involves long-distance trade (9,524km).

Competitiveness Analysis

Japan is an industrialised country placed 9th in the GCI of 2008/2009. The country has a significant competitive edge in market size (domestic: rank 4; foreign: rank 5) and consists of a well-developed infrastructure (overall infrastructure: rank 16; port infrastructure: rank 25).

Japan has a comparative advantage over the U.S. in manufacturing wages ($13.45 vs. $21.50), is competitive in primary manufacturing compensation costs ($32.41 vs. $31.82), and has a comparative advantage in fabricated product manufacturing compensation costs ($20.83 vs. $26.15).

Conclusion

The reduction of Japanese steel exports to the U.S. following a one-standard deviation oil price shock may be facilitated by long upstream and downstream trade distances. The decrease may remain short and statistically insignificant due to a moderate labour cost advantage of Japan over the U.S., Japan's good infrastructure and its significant market size. Moreover, the composition of steel exports may be dominated by high-value steel products which are less vulnerable to rising transport costs than low-value steel products.

The estimates for Japan may be biased by serial correlation (autocorrelation could not be eliminated by adding additional lags) and therefore need to be interpreted with caution. Additionally, Japanese steel exports to the U.S. are analysed per steel export category in section 6.4.8.2.

6.2.8.6 Malaysia

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to an increase of Malaysia's steel exports to the U.S. which lasts for one month (6qmt) and is statistically insignificant.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 12.4% of the volatility in the steel export variable. Therefore, the relative importance of the oil price variable for the steel export variable is moderate.

Granger Causality Analysis

There is Granger causality at the 5% level. The GC test result confirms the statistical usefulness or the predictive value of the oil price variable for the steel export variable.

Trade Distance Analysis

Malaysia does not produce coking coal domestically. Hence, the coking coal used for steel production needs to be imported. Malaysia is a net importer of iron ore (2008: 2,143tmt).

Importing coking coal from Australia involves long-distance trade (8,236km) while importing iron ore from Australia involves short-distance trade (3,708km). The reason for the different trade distances is that coking coal and iron ore are mined in different regions within Australia. It is unlikely that significant volumes of coking coal are imported from the distant United States (U.S. South Coast: 19,416km) or that significant volumes of iron ore are imported from distant Brazil (16,707km).

Exporting steel products from Malaysia to the U.S. West Coast involves very long trade distances (15,241km).

Competitiveness Analysis

Malaysia is an industrialising country placed 21st in the GCI of 2008/2009. Malaysia is ranked in the top twenty in the overall infrastructure (rank 19), port infrastructure (rank 16), and foreign market size (rank 17) rankings. Moreover, the country is ranked on position 35 in the domestic market size ranking. All in all, Malaysia is very competitive according to the competitiveness rankings used for the analysis.

No information is available on Malaysian labour costs but it can be assumed that labour costs in industrialising Malaysia are lower than in the industrialised United States.

Conclusion

The marginal and statistically insignificant increase of Malaysian steel exports to the U.S. following a one-standard deviation oil price shock despite significant upstream and very long downstream trade distances may result from the country's good overall competitiveness, good infrastructure, solid market size, and an assumed labour cost advantage over the United States.

However, it needs to be considered that the estimates for Malaysia may be biased by autocorrelation (serial correlation could not be eliminated by adding additional lags). Therefore, the estimates need to be interpreted with caution.

6.2.8.7 Philippines

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to an increase of the Philippine's steel exports to the U.S. which lasts for one month (67qmt) and is statistically insignificant.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 9.7% of the volatility in the steel export variable. Therefore, the relative importance of the oil price variable for the steel export variable is rather low.

Granger Causality Analysis

There is Granger causality at the 10% level. The GC test result confirms the statistical usefulness or the predictive value of the oil price variable for the steel export variable.

Trade Distance Analysis

The Philippines do not produce coking coal domestically. Hence, the coking coal used for steel production needs to be imported. Moreover, the country depends on imports of iron ore (2008: 2,700tmt).

Importing coking coal from Australia involves long-distance trade (7,515km) while importing iron ore from Australia involves moderate trade distances (4,348km). The reason for the different trade distances is that coking coal and iron ore are mined in different regions within Australia. It is unlikely that significant volumes of coking coal are imported from the distant United States (U.S. South Coast: 21,070km) or that significant volumes of iron ore are imported from distant Brazil (19,253km).
Exporting steel products from the Philippines to the U.S. West Coast involves very long trade distances (12,723km).

Competitiveness Analysis

The Philippines are a developing country placed 71st in the GCI of 2008/2009. While the country's market size is above average (domestic: rank 33; foreign: rank 40) by international standards, its infrastructure is significantly underdeveloped (overall infrastructure: rank 94; port infrastructure: rank 100).
The Philippines have a very significant comparative advantage over the U.S. in manufacturing wages ($1.19 vs. $21.50) and hourly compensation costs (primary metal manufacturing: $1.66 vs. $31.82; fabricated product manufacturing: $1.16 vs. $26.15).

Conclusion

The increase of the Philippines's steel exports to the U.S. following a one-standard deviation oil price shock despite significant upstream and very long downstream trade distances, below average overall competitiveness, and significantly underdeveloped infrastructure is surprising.
Although the Philippines are competitive in terms of market size and have a very significant labour cost advantage over the U.S., a negative impact of the oil price shock had been expected. However, the increase in steel exports to the U.S. remains short, marginal, and statistically insignificant.

6.2.8.8 Singapore

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to an increase of Singapore's steel exports to the U.S. which lasts for one month (183qmt) and is statistically insignificant.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 3.3% of the volatility in the steel export variable. Therefore, the relative importance of the oil price variable for the steel export variable is very low.

Granger Causality Analysis

There is Granger causality at the 10% level. The GC test result confirms the statistical usefulness or the predictive value of the oil price variable for the steel export variable.

Trade Distance Analysis

Singapore does not produce coking coal domestically. Hence, the coking coal used for steel production needs to be imported. No information is available about the country's domestic iron ore production, imports or exports.

Importing coking coal from Australia involves long-distance trade (7,978km) while importing iron ore from Australia would involve short-distance trade (3,365km). The reason for the different trade distances is that coking coal and iron ore are mined in different regions within Australia. It is unlikely that significant volumes of coking coal are imported from the distant United States (U.S. South Coast: 19,648km) or that significant volumes of iron ore are imported from distant Brazil (16,937km).

Exporting steel from Singapore to the U.S. West Coast involves very long trade distances (14,897km).

Competitiveness Analysis

Singapore is an industrialised country that has been placed 5th in the GCI of 2008/2009. The country's economy benefits from an excellent infrastructure (overall infrastructure: rank 2; port infrastructure: rank 1) and is very competitive in terms of foreign market size (rank 11). Singapore's domestic market size (rank 53) is rather average by international standards.

Singapore has a significant comparative advantage over the U.S. in manufacturing wages (\$10.45 vs. \$21.50) and hourly compensation costs (fabricated product manufacturing: \$12.15 vs. \$26.15). No information is available about compensation costs in the primary metal manufacturing sector.

Conclusion

The short and statistically insignificant increase of Singapore's steel exports to the U.S. following a one-standard deviation oil price shock despite long upstream trade distances for coking coal and very long downstream trade distances for steel exports to the U.S. may be due to Singapore's short import trade distances for iron ore, its excellent infrastructure including the best port infrastructure worldwide, significant labour cost advantages over the U.S., and significant foreign market size.

6.2.8.9 South Korea

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to a reduction of South Korean steel exports to the U.S. which lasts for two months. The impulse response peak is reached one month after the shock at -1,752qmt. The impulse response values are statistically insignificant.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 9% of the volatility in the steel export variable. Therefore, the relative importance of the oil price variable for the steel export variable is rather low.

Granger Causality Analysis

There is no Granger causality at the 1%, 5% or 10% level.

Trade Distance Analysis

Although South Korea produces coking coal domestically (2008: 11,967tst), it is one of the largest coking coal importers (2008: 24Mt). Moreover, South Korea produces only marginal volumes of iron ore (2008: 400tmt). Hence, iron ore needs to be imported (2008: 49,452tmt). Importing coking coal from the major exporting countries involves long trade distances in case of Australia (8,710km) and very long trade distances in case of the U.S. (Gulf Coast: 18,692km). Similarly, importing iron ore imports from the major exporting countries involves long/very long distance trade (Australia: 6,867km; Brazil: 21,680km).
Exporting steel products from South Korea to the U.S. West Coast also involves very long trade distances (10,345km).

Competitiveness Analysis

South Korea is an industrialised country placed 13th in the GCI of 2008/2009. South Korea has a well-developed overall infrastructure (rank 14) and a solid port infrastructure (rank 29). Moreover, the country among the top fifteen countries in terms of domestic (rank 14) and foreign market size (rank 9).
South Korea has a comparative advantage over the U.S. in hourly compensation costs (primary metal manufacturing: $21.40 vs. $31.82; fabricated product manufacturing: $14.35 vs. $26.15). No information is available about South Korean manufacturing wages.

Conclusion

The statistically insignificant reduction of South Korean steel exports to the U.S. following a one-standard deviation oil price shock lasts for two months and may be fostered by long/very long upstream trade distances for coking coal and iron ore and very long downstream trade distances for steel. The impact of the oil price shock may be counterbalanced to a certain extent by good infrastructure, relatively large market size and a labour cost advantage over the United States. Additionally, South Korean steel exports to the U.S. are analysed per steel export category in section 6.4.8.3.

6.2.8.10 Taiwan

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to a reduction of Taiwanese steel exports to the U.S. which lasts for four months. The impulse response peak is reached four months after the shock at -3,919qmt. The impulse response values are statistically insignificant.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 8.6% of the volatility in the steel export variable. Therefore, the relative importance of the oil price variable for the steel export variable is rather low.

Granger Causality Analysis

There is no Granger causality at the 1%, 5% or 10% level.

Trade Distance Analysis

Although Taiwan produces coking coal domestically (2008: 4,664tst), it is one of the largest coking coal importers (2008: 6Mt). Moreover, Taiwan imports large volumes of iron ore (2008: 15,571tmt).

Importing coking coal from the main exporting countries involves long trade distances in case of Australia (8,143km) and very long trade distances in case of the U.S. (Gulf Coast: 19,989km). Importing iron ore from the major exporters involves moderate trade distances in case of Australia (5,612km) and very long distance trade in case of Brazil (20,368km).

Exporting steel products from Taiwan to the U.S. West Coast involves very long trade distances (11,641km).

Competitiveness Analysis

Taiwan is in the transition phase from an industrialising to an industrialised country and is placed 17th in the GCI of 2008/2009. The infrastructure of the country is well developed (overall infrastructure: rank 22; port infrastructure: rank 18) by international standards and the country is among the top twenty nations in terms of market size (domestic: rank 18; foreign: rank 13).

Taiwan has a comparative advantage over the U.S. in hourly compensation costs (primary metal manufacturing: \$10.69 vs. \$31.82; fabricated product manufacturing: \$6.28 vs. \$26.15). No information is available about Taiwanese manufacturing wages.

Conclusion

The statistically insignificant reduction of Taiwanese steel exports to the U.S. following a one-standard deviation oil price shock lasts for four months and may be facilitated by long/very long upstream trade distances for coking coal and very long downstream trade distances for steel exports to the United States.

The impact of the oil price shock may be counterbalanced to a certain extent by the country's overall competitiveness, good infrastructure, relatively large market size and a significant labour cost advantage over the United States. Additionally, Taiwanese steel exports to the U.S. are analysed per steel export category in section 6.4.8.4.

6.2.8.11 Thailand

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to a reduction of Thailand's steel exports to the U.S. which lasts for four months. The impulse response peak is reached one month after the shock at -1,954qmt. The impulse response values are statistically insignificant.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 6.6% of the volatility in the steel export variable. Therefore, the relative importance of the oil price variable for the steel export variable is rather low.

Granger Causality Analysis

There is no Granger causality for the whole model at the 1%, 5% or 10% level.

Trade Distance Analysis

Thailand does not produce coking coal domestically. Therefore, the coking coal used for steel production needs to be imported. Thailand produces iron ore domestically (2008: 1,600tmt). No information is available about the country's iron ore imports and exports.

Upstream trade distances for Thailand's steel industry are as follows if raw materials are sourced from the main exporting countries: Long-distance trade is involved if coking coal is imported from Australia (9,266km) and very long distance trade is involved if coking coal is imported from the U.S. East Coast (21,185km). In case additional iron ore needs to be imported, sourcing from Australia involves moderate trade distances (4,650km). It is likely that the majority of iron ore is imported from Australia since importing from distant Brazil would involve very long trade distances (18,474km).

Exporting steel products from Thailand to the U.S. West Coast involves very long trade distances (15,099km).

Competitiveness Analysis

Thailand is an industrialising country placed 34th in the GCI of 2008/2009. The infrastructure of the country is above average by international standards (overall infrastructure: rank 35; port infrastructure: rank 48). Moreover, Thailand's economy profits from its relatively large market size (domestic: rank 23; foreign: rank 18).

No information is available about Thailand's labour cost levels. However, it can be assumed that the industrialising country has a comparative advantage over the industrialised U.S. in terms of labour costs.

Conclusion

The reduction of Thailand's steel exports to the U.S. following a one-standard deviation oil price shock lasts for four months and may be facilitated by long/very long upstream trade distances for coking coal and very long downstream trade distances for steel exports to the United States.

The impact of the oil price shock may be counterbalanced to a certain extent by the country's solid infrastructure, relatively large market size and an assumed labour cost advantage over the United States. The above-listed factors may be part of the explanation why the impulse response values are statistically insignificant.

6.2.8.12 Summary

The Asian countries included in the analysis can be separated into three groups:

- Group One: The first group consists of countries whose steel exports to the United States decline following a one-standard deviation oil price shock. Thereby, the reduction of steel exports to the U.S. is statistically significant (China, Hong Kong, India).
- Group Two: For the countries in the second group, steel export volumes to the U.S. decline but the impulse responses are statistically insignificant (Indonesia, Japan, South Korea, Taiwan, Thailand).
- Group Three: For the countries in the third group, steel exports to the U.S. increase but the increase is statistically insignificant (Malaysia, Philippines, Singapore).

Group One

It is noteworthy that China and India, the countries with the largest populations worldwide and the current drivers of global economic growth, are among the Asian nations whose export volumes to the U.S. are most adversely affected by a shock in the oil price variable. Comparing China and India based on the criteria used in the analysis shows, that the profile of both countries is quite similar:

- Both China and India are developing countries. Although China has an edge over India in terms of overall competitiveness, both countries are ranked among the top fifty countries in the GCI of 2008/2009 (China: rank 30; India: rank 50).
- China and India are ranked among the top five nations in terms of domestic (China: rank 2; India: rank 4) and foreign market size (China: rank 1; India: rank 5). An edge in market size may help to generate economies of scale. However, economies of scale can only be materialised if an industry is consolidated, not too fragmented.
- China and India have a very significant comparative advantage over the United States in terms of manufacturing wages (China: \$1.06; India: \$1.17; U.S.: \$21.50).

However, it seems that the factors described above cannot completely counterbalance the impact of an oil price shock on steel export volumes to the U.S., amongst other things due to the factors described below:

- Both countries are among the largest coking coal importers whose steel industries may be adversely affected by very long upstream trade distances.
- India has an edge over China in terms of iron ore abundance. While India belongs to the largest net exporters of iron ore, China is the largest net importer of iron ore. This difference in steelmaking raw material abundance may be one reason why the

impact on Chinese steel export volumes to the U.S. is stronger than the impact on Indian export volumes.

- Both nations face very long downstream trade distances for steel exports to the United States.
- Both China and India have relative weaknesses in terms of infrastructure. The lack of competitiveness in overall infrastructure (China: rank 58; India: rank 90) and port infrastructure (China: rank 54; India: rank 93) may add to the impact of high oil prices in combination with very long distance trade. Thereby, India should be even more affected than China due to its underdeveloped infrastructure.

Summing up, it seems that the advantages of the Chinese and Indian steel industries in labour costs and market size are outbalanced by the negative impacts of the oil price shock. Thereby, the decomposition of exports may also play a role if the export portfolio of both countries is dominated by low-value steel products which are overproportionally affected by rising oil prices or transport costs. The excursus ‘U.S. Steel Industry vs. Chinese Steel Industry’ provides further insight into the reasons for China’s decreasing steel exports following an oil price shock.

Although industrialised Hong Kong is performing significantly better than developing China and India in terms of overall competitiveness and infrastructure, is competitive with regard to market size, and probably benefits from a more favourable composition of steel exports in comparison with China and India, the effect of large trade distances and an oil price shock also leads to statistically significant declining steel export volumes to the United States.

Group Two

The second group includes industrialised Japan and the Tiger States South Korea and Taiwan. The three countries are among the top twenty nations with regard to overall competitiveness (Japan: rank 9; South Korea: rank 13; Taiwan: rank 17), domestic market size (Japan: rank 3; South Korea: rank 14; Taiwan: rank 18), and foreign market size (Japan: rank 4; South Korea: rank 9; Taiwan: rank 13), and among the top thirty nations in terms of overall infrastructure (Japan: rank 16; South Korea: rank 18; Taiwan: rank 22) and port infrastructure (Japan: rank 25; South Korea: rank 29; Taiwan: rank 18). Moreover, the three countries have a moderate (Japan) or significant (South Korea, Taiwan) labour cost advantage over the United States. Although the steel export figures of these countries to the U.S. decline in reaction to the one-standard deviation oil price shock, the decline is statistically insignificant. The competitiveness of those countries may help easing the impact of the oil price shock.

In view of Japan, it needs to be mentioned that results may be biased by serial correlation and therefore need to be interpreted with caution.

Industrialising Thailand is part of group two because the decline of Taiwanese steel exports to the U.S. is also statistically insignificant. Although the Taiwanese steel industry is confronted with long upstream trade distances for coking coal and very long downstream trade distances for steel, it profits from moderate upstream trade distances for iron ore when imports come from Australia. Moreover, the country is ranked among the top twenty nations in all competitiveness sub-categories included in the analysis which may help easing the impact of the oil price shock.

Developing Indonesia completes the list of countries in group two. It seems that the statistical insignificance of the steel export decline has less to do with competitiveness and may rather be due to the country's steelmaking raw material abundance. As a consequence, the Indonesian steel industry does not face international upstream trade costs, at least for coking coal and iron ore. Therefore, the industry can only be impacted by rising oil prices through the downstream transport cost channel.

Group Three

Group three consists of the developing Philippines, industrialising Malaysia, and industrialised Singapore. The impulse responses of the countries included are characterised by a short and statistically insignificant immediate reaction to a one-standard deviation oil price shock. Thereby, it is remarkable that the economies of three countries whose steel industries seem to be able to absorb the impact rising oil prices are at different stages of development.

The listing of the Philippines in group three comes at a surprise. The only factor that might potentially explain the resilience of the country's steel industry may be a very significant labour cost advantage over the United States.

In the case of Malaysia, the reasons for the ability of the steel industry to absorb rising transport costs despite significant upstream and downstream trade distances are more obvious as the country's economy is very competitive by international standards (rank 21). Moreover, Malaysia is ranked among the top twenty nations in three sub-criteria also included in the analysis (overall infrastructure: rank 19; port infrastructure: rank 16; domestic market size: rank 17) and is expected to have a labour cost advantage over the United States. However, it needs to be emphasised that the results for Malaysia may be biased by autocorrelation. Therefore, the estimates should be treated with caution.

Finally, the reasons for the resilience of Singapore's steel industry against rising transport costs is most obvious. The economy of the Tiger state is on position five in terms of overall competitiveness and profits from the best port infrastructure worldwide, the second-best overall infrastructure, a large foreign market size (rank 11), a significant labour cost advantage over the U.S., and possibly from a favorable composition of exported steel products.

By and large, the findings for the Asian countries included in the analysis are in line with the hypothesis that oil price shocks or rising maritime fuel costs lead to a regionalisation of trade flows and to a reduction of trade distances in the global economy. This especially applies for China, Hong Kong, and India and to a somewhat lesser extent for Indonesia, Japan, South Korea, Taiwan, and Thailand.

6.2.9 Oceania

Section 6.2.9 analyses the econometric estimates for Australia (6.2.9.1) and New Zealand (6.2.9.2).

Table 6.19 VEC Analysis - Oceania

Country	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Decomposition (after 15 months, in %)	Granger Causality (p-value)
Australia	1	-5,826 **	41.7	0.46
New Zealand	1	-47	9.4	0.37
	2	-745 *		

Source:
Author's calculations (EViews®®)

* statistically significant at 68% error bands
** statistically significant at 90% error bands
*** statistically significant at 95% error bands

6.2.9.1 Australia

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to a reduction of Australian steel exports to the U.S. which lasts for one month (-5,826qmt) and is statistically significant at 90% error bands.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 41.7% of the volatility in the steel export variable. Therefore, the relative importance of the oil price variable for the steel export variable is very high.

Granger Causality Analysis

There is no Granger causality at the 1%, 5% or 10% level.

Trade Distance Analysis

Australia is the largest exporter of coking coal (2008: 137Mt) and iron ore (2008: 308,931tmt). Hence, the Australian steel industry profits from steelmaking raw material abundance.

Exporting steel products from Australia to the U.S. West Coast involves very long trade distances (13,930km).

Competitiveness Analysis

Australia is an industrialised country placed 18th in the GCI of 2008/2009. The country's overall infrastructure is well developed (rank 25) and the quality of its port infrastructure is above average by international standards (rank 41). Australia is among the top twenty nations in terms of domestic market size (rank 17). Its foreign market size is somewhat smaller (rank 34).

Australia has a slight labour cost disadvantage compared to the U.S. in manufacturing wages ($23.90 vs. $21.50), a moderate disadvantage in compensation costs in the fabricated manufacturing sector ($30.59 vs. $26.15), and a significant disadvantage in compensation costs in the primary metal manufacturing sector ($38.34 vs. $31.82).

Conclusion

The statistically significant reduction of Australia's steel exports to the U.S. following a one-standard deviation oil price shock may be due to very long downstream trade distances and may be facilitated by a comparative disadvantage in labour costs in comparison with the United States.The downturn in steel exports to the U.S. is rather short-termed. This may especially be due to Australia's domestic steelmaking raw material abundance and to a lesser extent to its solid infrastructure and market size. Additionally, Australian steel exports to the U.S. are analysed per steel export category in section 6.4.9.

6.2.9.2 New Zealand

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to a decrease of New Zealand's steel exports to the U.S. which lasts for two months. The impulse response peak is reached two months after the shock at -744qmt. The impulse response value for the second month after the shock is statistically significant at 68% error bands.

Variance Decomposition Analysis

Fifteen months after the shock, the oil price variable accounts for 9.4% of the volatility in the steel export variable. Therefore, the explanatory power of the oil price variable for the steel export variable is rather low.

Granger Causality Analysis

There is no Granger causality at the 1%, 5% or 10% level.

Trade Distance Analysis

New Zealand is a significant exporter of coking coal (2010: 2Mt). The country produces iron ore domestically (2008: 2,300tmt) and exports a significant amount of its domestic production (2008: 500tmt). Therefore, although no data are available for exports it can be assumed that New Zealand does not depend on iron ore imports.

Exporting steel products from New Zealand to the U.S. West Coast involves very long trade distances (12,169km).

Competitiveness Analysis

New Zealand is an industrialised country placed 24th in the GCI of 2008/2009. While the quality of the country's overall infrastructure is fair average by international standards (rank 50), its port infrastructure is well developed (rank 23). New Zealand's market size is rather average by international standards (domestic: rank 57; foreign: rank 71).

The country has a moderate comparative advantage in manufacturing wages over the U.S. ($15.95 vs. $21.50). No information is available about the country's hourly compensation costs.

Conclusion

The statistically significant reduction of New Zealand's steel exports to the U.S. following a one-standard deviation oil price shock may be due to very long downstream trade distances The downturn in steel exports to the U.S. is rather short. This may especially be due to New Zealand's steelmaking raw material abundance and to a lesser extent to its solid infrastructure and market size and a moderate manufacturing cost advantage over the United States.

6.2.9.3 Summary

A one-standard deviation shock in oil prices leads to a reduction of steel imports to the U.S. for both Oceanian countries included in the analysis. The reduction is rather short but statistically significant in both cases.

The decreasing steel exports to the U.S. are likely to be facilitated by very long downstream trade distances/transport costs. The decrease in steel exports might be limited by steelmaking raw material abundance in Australia and New Zealand and by the overall competitiveness of both countries. Soft factors such as common language and cultural affiliation may also play a role.

The findings for the Oceanian countries included in the analysis are in line with the hypothesis that oil price shocks or rising maritime fuel costs lead to a regionalisation of trade flows and to a reduction of trade distances in the global steel industry.

6.3 Analysis of Steel Exports to the U.S. by Region

In section 6.3, the estimates for the steel export countries from Europe (6.3.1), the C.I.S. (6.3.2), North America (6.3.3), South America (6.3.4), Africa (6.3.5), the Middle East (6.3.6), Asia (6.3.7), and Oceania (6.3.8) are summarised and analysed statistically. Section 6.3.9 concludes.

6.3.1 Europe

6.3.1.1 European Union

The study includes 23 of 27 EU members. The VEC model estimates (IRF, VD) the GC test, the upstream and downstream steel trade distances, and the competitiveness rankings for those EU countries can be summarised as follows:

<u>Impulse Response Analysis</u>

A one-standard deviation shock to the real oil price leads to decreasing steel exports to the U.S. in 20 of the 23 EU member countries surveyed and to increasing steel exports in 3 countries. The immediate decline for the 23 EU members lasts for an average of 2.9 months. The average decline for the 20 countries with declining export figures is 3.5 months while the average increase for the 3 countries (Ireland, Romania, UK) with increasing export figures is 1 month. 26 of the 72 estimated single impulse response values are statistically significant (68% error bands: 18; 90% error bands: 5; 95% error bands: 3), a relative share of 36.1%. Thereby, all statistically significant single impulse response values can be attributed to countries with decreasing steel export figures.

<u>Variance Decomposition Analysis</u>

The explanatory power of the oil price variable for the steel export variable is very low for 3 countries, low for 6 countries, medium for 5 countries, high for 7 countries, and very high for 2 countries. The average relative importance of the oil price variable for the steel export variables of the 23 EU members is 17.5% (medium), 18.7% (medium) for the 20 members with decreasing export figures, and 9.1% (low) for the 3 members with increasing export figures.

Comparing the average relative importance of the explanatory variables to the volatility of the steel export variable (oil price: 17.5 %; steel import value: 10.8%; exchange rates: 9.1%; U.S. real GDP: 7.3%) shows that the oil price variable has the largest explanatory power of all explanatory variables. To put it differently, the oil price variable explains most of the variation in the steel export variable relative to the other explanatory variables for 13 of 23 or for 56.5% of the EU members analysed.

Granger Causality Analysis

The GC test results confirm the statistical usefulness or the predictive value of the oil price variable for the steel export variable for 8 of 23 countries, (1% level: 3; 5% level: 3; 10% level: 2), a relative share of 34.8%.

Trade Distance Analysis

Five of the 23 EU-member states are landlocked and 18 are not landlocked. The shortest steel export trade routes to the U.S. for all 18 countries with an own seaport infrastructure are trade routes between Europe and the U.S. East Coast. The average trade distance between the EU and the U.S. is 6,834km (calculated on the basis of the shortest trade route between each EU member and the U.S.). Thereby, the calculated trade distances for EU-member countries to the U.S. East Coast are between 5,672km (Portugal) and 9,919km (Romania).

The EU is a significant net importer of iron ore. In 2008, the EU imported 138,651tmt of iron ore. None of the top five iron ore exporting countries (Australia, Brazil, India, South Africa, Ukraine) accounting for 82.5% of worldwide iron ore exports in 2011 is a member of the EU.

Regarding coking coal, no net import/export figures can be calculated due to a lack of data availability. However, in 2011 only two EU members were among the largest coking coal exporters (Czech Republic: 2.1Mt; Poland: 1.7Mt). At the same time, three EU-members were among the largest coking coal importers (Germany: 9Mt; Italy: 5.6Mt; UK: 6Mt). It can be assumed that significant upstream trade distances are involved when supplying EU member countries with iron ore and coking coal to meet their demand.

Competitiveness Analysis

The average rank of the 23 EU-members in the GCI of 2008/2009 is position 30 (of 134). Moreover, the average rank is 41 for overall infrastructure, 43 for port infrastructure, 41 for domestic market size, and 37 for foreign market size.

In terms of labour costs, data for manufacturing wages are available for 18 of the 23 countries. Thereby, manufacturing wages are lower than in the U.S. in 10 of the 18 countries and higher in 8 countries. Data for hourly compensation costs in the primary metal manufacturing sector are available for 14 of 23 countries. Compensation costs are lower than in the U.S. in 4 of those countries and higher in 10 countries. Data for hourly compensation costs in the fabricated product manufacturing sector are available for 13 countries. Compensation costs are lower than in the U.S. in 5 of those countries and higher in 8 countries. While a small majority of EU countries is competitive or has a comparative advantage in manufacturing wages in relation to the U.S., the majority of EU countries face higher compensation costs than the United States (see table 6.20 and table 6.21).

Table 6.20 Labour Costs - European Union

	Manufacturing Wages (in U.S. $)			Hourly Compensation Costs (in U.S. $)					
				Primary Metal Manufacturing			Fabricated Product Manufacturing		
	Ø	min.	max.	Ø	min.	max.	Ø	min.	max.
Industrialising Countries	4.89	4.49	- 5.66	11.96	10.04	- 14.15	7.57	6.98	- 7.96
Industrialised Countries	18.06	5.88	- 32.56	38.56	11.21	- 55.09	30.49	9.44	- 41.17
Total	15.13	4.49	- 32.56	32.86	10.04	- 55.09	25.20	6.98	- 41.17

Source: Author's calculations; U.S. Bureau of Labor Statistics 2011

Comparing average manufacturing wages for EU members with U.S. manufacturing wages shows that average manufacturing wages in the EU are about $6 lower than in the U.S. ($15.13 vs. $21.50). Wage differences are more pronounced between industrialising EU countries and the U.S. ($4.89 vs. $21.50) and less pronounced between industrialised EU countries and the U.S. ($18.06 vs. $21.50).

Table 6.21 Wages 2007 - United States

Country	Manufacturing Wages (in $)	Hourly Compensation Costs (in $)	
		Primary Metal Manufacturing	Fabricated Product Manufacturing
United States	21.50	31.82	26.15

Source: U.S. Bureau of Labor Statistics 2011

Comparing average hourly compensation costs in EU countries with the U.S. compensation costs shows that average compensation cost levels are slightly higher for EU members in the primary metal manufacturing sector ($32.86 vs. $31.82) and slightly lower in the fabricated product manufacturing sector ($25.20 vs. $26.15). Discriminating between industrialising and industrialised EU members reveals that on average, industrialising members have a comparative advantage over the U.S. (primary metal manufacturing: $11.96 vs. $31.82; fabricated metal manufacturing: $7.57 vs. $26.15). On the other hand industrialised members face a comparative disadvantage (primary metal manufacturing: $38.56 vs. $31.82; fabricated metal manufacturing sector: $30.49 vs. $26.15).

It can be assumed that industrialising EU countries primarily compete based on production costs while industrialised EU countries primarily compete based on quality.

6.3.1.2 Other Europe

The study includes two European countries which are not members of the EU, Norway and Switzerland.

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to decreasing steel exports to the U.S. in the case of Norway and to increasing steel exports to the U.S. for Switzerland. The immediate decline for both countries lasts for an average of 1 month. Three of the 8 single impulse response values are statistically significant (68% error bands: 1; 95% error bands: 2), a relative share of 37.5%. Thereby, one statistically significant impulse response value is negative (Norway) and two significant impulse response values are positive (Switzerland).

Variance Decomposition Analysis

In terms of the relative importance of a one-standard deviation oil price shock to the volatility of steel exports from other European countries (non-EU members) to the U.S., fifteen months after the oil price shock the relative importance is high for Norway and Switzerland.

Comparing the average relative importance of the explanatory variables to the volatility of the steel export variable (oil price: 23.3%; steel import value: 20%; exchange rates: 4.4%; U.S. real GDP: 3.8%) shows that the oil price variable has the largest explanatory power of all explanatory variables.

Granger Causality Analysis

There is Granger causality for Switzerland at the 1% level. There is no Granger causality in the case of Norway.

Trade Distance Analysis

Because Switzerland is landlocked, steel export trade distances to the U.S. can only be calculated for Norway (U.S. East Coast: 6,278km).

Both European non-EU member countries are net importers of iron ore. In 2008, combined iron ore net imports were 1,943tmt.

Norway and Switzerland do not produce coking coal domestically. Therefore, the coking coal used for steel production needs to be imported. It can be assumed that considerable upstream trade distances are involved when supplying Norway and Switzerland with iron ore and coking coal to meet their demand.

Competitiveness Analysis

The average ranking for Switzerland and Norway in the GCI of 2008/2009 is position 9 (of 134). Moreover, the average ranking is 15 for overall infrastructure and for port infrastructure, 41 for domestic market size, and 36 for foreign market size.

The only labour cost figures available are hourly compensation costs in the primary metal manufacturing sector for Norway ($53.57; U.S.: $31.82) and manufacturing wages for Switzerland ($28.17; U.S.: $21.50). Both figures indicate a comparative disadvantage of Norway and Switzerland when compared to the United States.

6.3.1.3 Further Analysis

European countries make up the largest share of countries included in the study. Altogether, 25 European countries, 23 EU-members and 2 non-EU members, are analysed.

On average, European economies are quite competitive by international standards. Comparing the average competitiveness of the European countries with the average competitiveness of the other regions shows that Europe is only 6th of 8 in the domestic market size ranking (average rank: 41) but 4th in the foreign market size ranking (average rank: 37) and 2nd in the rankings for overall competitiveness (average rank: 28), overall infrastructure (average rank: 39), and port infrastructure (average rank: 40).

Nonetheless, steel exports to the U.S. decrease in 21 of 25 European countries following a one-standard deviation oil price shock. On average, exports to the U.S. decrease for a period of 2.7 months. There are a couple of possible reasons for this:

First, although the average distance of trade calculated is below average (6,805km vs. 8,164km), it falls into the long-distance trade category. The role of trade distances for European steel industries is essential because Europe is poor in natural resources. Therefore, large amounts of steelmaking raw materials such as iron ore and coking coal need to be imported, thereby making necessary long-distance upstream trade. As a consequence, most European steel industries are punished twice by increasing transport costs, first for the import of raw materials from distant resource-rich countries such as Australia or Brazil, and second by increasing transport costs for the export of steel to the United States.

Second, six European countries are landlocked which further increases upstream and downstream transport costs due to expensive overland transport. Only European landlocked countries are able to export significant amounts of steel to the United States (A notable exception is Kazakhstan which is semi-landlocked because the Caspian Sea is not directly connected to other oceans.). Steel exports to the U.S. decrease in all European landlocked countries (Austria, Czech Republic, Hungary, Luxembourg, Slovakia) following an oil price shock with the exception of Switzerland.

Third, European welfare states implicate high labour cost levels. The labour cost structure in Europe is above average for industrialising economies primarily competing based on price and for industrialised countries primarily competing based on quality. For example, Poland, which is in the transition phase to an industrialised country, has a comparative disadvantage in labour costs against U.S. neighbour Mexico (hourly compensation costs primary metal manufacturing: $10.04 vs. $5.81; hourly compensation costs fabricated metal manufacturing: $7.78 vs. $3.39). Likewise, many industrialised European countries have a comparative disadvantage in labour costs when compared to industrialised U.S. neighbour Canada.

Fourth, the European countries face disadvantages compared to the U.S. neighbours Canada and Mexico in terms of cultural affiliation, common language (with the exception of Ireland and the UK), and common borders.

Due to the reasons outlined above, it is reasonable to link the decreasing steel export figures to rising oil prices/transport costs in connection with trade distance and geographic location and to Europe's labour cost structure.

When it comes to the four European countries where steel exports to the U.S. increase, Ireland and the UK may profit from cultural affiliation and common language while landlocked Switzerland may profit from its excellent overall competitiveness (rank 2 of 134) and overall infrastructure (rank 1). Finally, the estimates for Romania may be biased by serial correlation. The increase in export figures for the four countries is statistically insignificant with the exception of Switzerland.

6.3.2 C.I.S.

The study includes three C.I.S. countries, Kazakhstan, Russia and Ukraine.

<u>Impulse Response Analysis</u>

A one-standard deviation shock to the real oil price leads to decreasing steel exports to the U.S. in the three C.I.S. countries analysed. The immediate decline lasts for an average of 4.3 months. Five of the 13 single impulse response values estimated are statistically significant

(68% error bands: 1; 90% error bands: 3; 95% error bands: 1), a relative share of 38.4%. All statistically significant single impulse values are negative.

Variance Decomposition Analysis

In terms of the relative importance of a one-standard deviation oil price shock to the volatility of steel exports from C.I.S. countries to the U.S., fifteen months after the oil price shock the relative importance is moderate for Russia, high for Ukraine, and very high for Kazakhstan. The average relative importance for the three nations is 26.9% (high).

Comparing the average relative importance of the explanatory variables to the volatility of the steel export variable (oil price: 26.9 %; steel import value: 7.8%; exchange rates: 8.4%; U.S. real GDP: 14.1%) shows that the oil price variable has the largest explanatory power of all explanatory variables. To put it differently, the oil price variable explains most of the variation in the steel export variable relative to the other explanatory variables for 2 of 3 C.I.S. countries analysed.

Granger Causality Analysis

The GC test result confirms the statistical usefulness or the predictive value of the oil price variable for the steel export variable for 2 of 3 countries at the 1% level.

Trade Distance Analysis

Of the three C.I.S states included in the analysis, one is effectively landlocked (Kazakhstan has only access to the Caspian Sea which is not directly linked to other oceans.). For Russia and Ukraine, the shortest steel export trade route to the U.S. is the trade route between each country and the U.S. East Coast. The average trade distance between the C.I.S. region and the U.S. is 9,121km (calculated on the basis of the shortest trade route between each C.I.S. country and the U.S.). Thereby, the trade distance is 8,100km for Russia and 10,141km for the Ukraine.

The C.I.S. region is a net exporter of iron ore (net exports in 2008: 46,053tmt). In this context, Ukraine is among the top five iron ore exporters (3% of global exports or 34.1mmt in 2011).

Kazakhstan (exports in 2011: 1Mt) and Russia (exports in 2011: 14Mt) are among the main coking coal exporters and Ukraine is producing coking coal domestically.

Therefore, the region is largely self-sufficient regarding coking coal and iron ore which gives the region a comparative advantage.

Competitiveness Analysis

The average ranking of the three C.I.S. countries in the GCI of 2008/2009 is position 63 (of 134). Moreover, the average rank is 78 for overall infrastructure, 88 for port infrastructure, 30 for domestic market size, and 31 for foreign market size. No labour cost data are available for the three C.I.S. countries.

Further Analysis

The average competitiveness of the C.I.S. countries analysed is below average relative to the average competitiveness of the other regions with the exception of market size where the average of the surveyed countries from the region is 2nd of 8 in both categories (average rank domestic market size: 30; average rank foreign market size: 31). In terms of overall competitiveness, the region is 5th of 8 (average rank: 63) and 7th of 8 in the rankings for overall infrastructure (average rank: 78) and port infrastructure (average rank: 88).
Steel exports to the U.S. decrease for the three countries from the region following an oil price shock. Thereby, the average downturn (-4.3 months) is the longest of all regions. Five of 13 or 38.4% of the impulse response values are statistically significant. All 13 values are negative. Moreover, the average relative volatility in the steel export variable that can be explained by volatility in the oil price variable (23.6%) is significantly above average (16.1%) which also indicates the importance of oil prices/transport costs for steel exports to the United States.
The distance of trade seems to be a significant determinant of the declining export figures. Although the steel industries of the countries surveyed do not depend on iron ore and coking coal imports from distant locations and are hence not affected by long-distance upstream transport costs, the average downstream trade distance estimated (9,121km) is above average (8,164km). The effect of downstream trade distances might be accelerated by the region's underdeveloped (port) infrastructure. In the case of Kazakhstan, whose steel industry is the most affected in the region, the fact that the country is 'semi-landlocked' may also play a role. Kazakhstan is only connected directly to the Caspian Sea which is not directly connected to other oceans so that direct ocean transport from Kazakhstan to the U.S. is not possible.

6.3.3 North America

The study includes nine North American countries. The VEC-model estimates (IRF, VD, GC), the upstream and downstream trade distances, and the competitiveness rankings for those countries can be summarised as follows:

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to decreasing steel exports to the U.S. in none of the North American countries surveyed. Instead, steel export figures increase for the 9 countries analysed. The immediate increase for the countries surveyed lasts for an average of 3.9 months. 11 of the 35 single impulse response values are statistically significant (68% error bands: 8; 90% error bands: 2; 95% error bands: 1), a relative share of 31.4%. All statistically significant impulse response values can be attributed to countries with increasing steel export figures.

Variance Decomposition Analysis

The explanatory power of the oil price variable for the steel export variable is very low for 1 country, low for 2 countries, medium for 4 countries, high for 2 countries, and very high for none of the countries.

Comparing the average relative importance of the explanatory variables to the volatility of the steel export variable (oil price: 14.4 %; steel import value: 12.4%; exchange rates: 10.6%; U.S. real GDP: 6.5%) shows that the oil price variable has the largest explanatory power of all explanatory variables. To put it differently, the oil price variable explains most of the variation in the steel export variable relative to the other explanatory variables for 4 of 9 or 44.4% of the North American countries analysed.

Granger Causality Analysis

The GC test result confirms the statistical usefulness or the predictive value of the oil price variable for the steel export variable for 4 of 9 countries, (1% level: 3; 10% level: 1), a relative share of 44.4%.

Trade Distance Analysis

None of the nine North American countries is landlocked. The shortest sea trade routes between the countries analysed and the United States are trade routes to the U.S. West Coast in one case, trade routes to the U.S. East Coast in two cases, and trade routes to the U.S. Gulf Coast in six cases. The average trade distance between the North American states and the U.S. is 2,492km (calculated on the basis of the shortest trade route between each exporting country and the U.S.). Thereby, trade distances are between 1,140km (Canada) and 4,054km (El Salvador).

North America is a net exporter of iron ore. In 2008, North American iron ore net exports were 14,376tmt. No net import/export figures can be calculated for coking coal due to a lack of data available. However, in 2011 Canada (28Mt) and the United States (63Mt) accounted for 33% of worldwide coking coal exports. Hence, it can be assumed that the region has a comparative advantage in steelmaking raw material abundance in addition to the advantage of the short trade distances for exporting steel to the United States.

Competitiveness Analysis

The average rank of the 9 North American countries in the GCI of 2008/2009 is position 69 (of 134). Moreover, the average ranks calculated are rank 62 for overall infrastructure, 66 for port infrastructure, 67 for domestic market size, and 70 for foreign market size.

Labour cost figures are only available for Canada (manufacturing wages: $22.40; hourly compensation costs primary metal manufacturing: $44.71; hourly compensation costs fabricated product manufacturing: $29.59) and Mexico (hourly compensation costs primary metal manufacturing: $5.81; hourly compensation costs fabricated product manufacturing: $3.39). Due to the fact that the remaining countries from the region analysed are all developing or industrialising countries, it can be assumed that their labour cost levels are similar to Mexican labour costs which would give all countries but Canada a comparative advantage over the U.S. in terms of labour costs.

Further Analysis

The average competitiveness of the North American countries surveyed is below average by international standards. When comparing the average competitiveness of the North American countries with the average competitiveness calculated for the countries from the other regions, North America is 6th of 8 in the overall competitiveness ranking (average rank: 69), 5th in overall (average rank: 62) and port infrastructure rankings (average rank: 66), and 8th in the domestic (average rank: 67) and foreign market size rankings (average rank: 70). That is, the region is underperforming in relation to most other regions. The picture is even more clear when Canada is excluded (8th of 8 in overall competitiveness (average rank: 77), domestic (average rank: 74) and foreign market size (average rank: 77); 7th in overall infrastructure (average rank: 69); 5th in the category of port infrastructure (average rank: 73)).

However, despite the region's relative inability to compete internationally in the rankings selected for analysis, steel exports to the U.S. increase for all 9 countries following an oil price shock. On average, exports to the U.S. increase for a period of 3.9 months. Since the increase is certainly not a result of the region's relative competitiveness, distance of trade is a logical candidate for explaining the rising steel export volumes. The average trade distance calculated for steel exports from all 64 countries to the U.S. is 8,164km. The average trade distance for the 9 North American countries, however, is only 2,492km. This figure is about 70% below the average trade distance and by far the lowest average trade distance of all regions.

It can be assumed that the steel industry of industrialised Canada primarily competes based on quality and therefore increases its export figures to the neighbouring U.S. at the cost of steel industries of more distant industrialised countries also primarily competing based on quality. At the same time, it can be assumed that the 8 remaining developing and industrialising North American countries, for example Mexico, primarily compete based on price and therefore increase their export market share at the expense of steel industries of more distant developing and industrialising countries which also primarily compete based on price.

A major component of production costs are labour costs which are often the main reason to import from abroad. In 2008, manufacturing wages paid in China were at $1.06 while hourly compensation costs in Mexico were at $5.81 in the primary metal manufacturing sector and at $3.39 in the fabricated manufacturing sector. If one adds the additional expenses included in the hourly compensation cost ratio to Chinese manufacturing wages (Unfortunately, no data on manufacturing wages are available for Mexico and no data on compensation costs are available for China so that the figures cannot be compared directly.), the small labour cost margin (For instance, the difference between Chinese manufacturing wages and Mexican compensation costs in the fabricated product manufacturing sector is only $2.33.) between China and Mexico shrinks even more. As both countries primarily compete based on price, the relatively small labour cost advantage of China over Mexico may be neutralised or even reversed at high oil price levels due to the substantial differences in trade distance with the United States.

The situation for steel industries competing primarily based on quality may be similar. In case the Canadian steel industry is able to produce the same qualities of steel as the German steel industry, why should the United States import from relatively distant Germany where labour costs are above Canadian labour costs (manufacturing wages: $25.05 vs. $22.40; compensation costs primary metal manufacturing: $55.09 vs. $44.71; compensation costs fabricated product manufacturing: $41.17 vs. $29.59), not to mention the considerably higher downstream costs for imports from Germany at high oil price levels? Similar labour cost differences exist between Canada and other European Countries such as Belgium, Finland, or Sweden.

In case of Canada and Mexico, additional factors such as the NAFTA membership, common borders, Maquiladoras (Mexico), cultural affiliation (Canada) or common language (Canada) may add to the advantage of short-distance transport.

Presumably for these reasons, Canadian steel exports to the U.S. were up 21.3% on a year-over-year basis for the first three quarters of 2008, while steel exports from Mexico to the U.S. were up 6.8% for the same time period.

Summing up, the steel industries of the North American countries included in the analysis clearly benefit from an oil price shock (allegedly at the expense of the steel industries of more distant countries with a similar structure) when it comes to exports to the United States.

6.3.4 South America

The study includes 7 South American countries. The VEC model estimates (IRF, VD, GC), the upstream and downstream steel trade distances, and the competitiveness rankings for those countries can be summarised as follows:

Impulse Response Analysis

A one-standard deviation oil price shock leads to increasing steel exports to the U.S. in 4 of the 7 countries surveyed and to decreasing steel exports in 3 countries. The immediate increase for the 7 South American countries lasts for an average of 0.7 months. The average decrease for the 3 countries (Argentina, Ecuador, Uruguay) with declining export figures is 1.3 months while the average increase for the 4 countries (Brazil, Chile, Colombia, Peru) with increasing export figures is 2.3 months. Three of the 13 single impulse response values are statistically significant at 68% error bands, a relative share of 23.1%. Thereby, all statistically significant impulse response values can be attributed to countries with increasing steel export figures.

Variance Decomposition Analysis

The explanatory power of the oil price variable for the steel export variable is very low for 2 countries, low for 1 country, medium for 3 countries, high for 1 country, and very high for none of the countries. The average relative importance for the South American countries is 11.8% (medium), 15.8% (medium) for the 4 countries with increasing export figures and 6.5% (low) for the 3 countries with decreasing export figures.

Comparing the average relative importance of the explanatory variables to the volatility of the steel export variable (oil price: 11.8 %; steel import value: 11.5%; exchange rates: 6.8%; U.S. real GDP: 2.9%) shows that the oil price variable has the largest explanatory power of all explanatory variables. To put it differently, the oil price variable explains most of the variation in the steel export variable relative to the other explanatory variables for 3 of 7 or 42.9% of the South American countries analysed.

Granger Causality Analysis

The GC test result confirms the statistical usefulness or the predictive value of the oil price variable for the steel export variable for 2 of 7 countries at the 5% level, a relative share of 28.6%.

Trade Distance Analysis

None of the 7 South American countries included in the analysis is landlocked. The shortest sea trade routes between the countries analysed and the U.S. include trade routes to the U.S. West Coast in 4 cases and trade routes to the U.S. East Coast in 3 cases. The average steel export trade distance between the South American states and the U.S. is 6,901km (calculated on the basis of the shortest trade route between each exporting country and the U.S.). Thereby, the trade distances calculated are between 2,763km (Colombia) and 11,352km (Argentina). The region can be split along trade distances. The South American countries located in the north of the region benefit from short or moderate trade distances to the U.S. (the trade distances estimated for Brazil, Colombia, Ecuador and Peru are between 2,763km and 5,876km). Trade distances for countries in the south of the region are long or very long (the trade distances calculated for Argentina, Chile, and Uruguay are between 7,756km and 11,352km).

South America is a very significant net exporter of iron ore. In 2008, iron ore net exports from South America were 291,901tmt. This figure is mainly due to Brazil which is the second-largest exporter of iron ore and accounted for 30.2% of total iron ore exports in 2011. No net import/export figures can be calculated for coking coal due to a lack of data available. However, Colombia is the only significant South American coking coal exporter (1Mt in 2010) and Brazil is one of the most significant coking coal importers (12Mt in 2010). It can therefore be assumed that the region is a net importer of coking coal. Hence, South America is only partially resource abundant when it comes to steel making raw materials.

Competitiveness Analysis

The average ranking of the South American countries analysed in the GCI of 2008/2009 is position 74 (of 134). Moreover, the average ranks are 83 for overall infrastructure, 92 for port infrastructure, 43 for domestic market size, and 54 for foreign market size.

Labour cost figures are only available for Argentina (manufacturing wages: $5.47; hourly compensation costs primary metal manufacturing: $11.73; hourly compensation costs fabricated product manufacturing: $6.50) and Brazil (manufacturing wages: $3.81; hourly compensation costs primary metal manufacturing: $12.27; hourly compensation costs fabricated product manufacturing: $5.95). Both countries have a significant labour cost advantage over the United States. Due to the fact that the countries from the region are all industrialising countries, it can be assumed that the steel industries of the other countries analysed also profit from a labour cost advantage over the United States.

Further Analysis

On average, the South American countries analysed are even less competitive than the North American countries. When comparing their average competitiveness with the average competitiveness estimated for the other regions, South America is 7th of 8 in overall competitiveness (average rank: 74) and foreign market size (average rank: 54), and 8th of 8 in overall infrastructure (average rank: 83), port infrastructure (average rank: 92), and domestic market size (average rank: 43). In other words, compared to the other regions the region is relatively un-competitive.

Nonetheless, following an oil price shock steel exports to the U.S. increase in 4 of 7 countries surveyed. On average, exports increase by 0.7 months so that the balance of the region is slightly positive.

In terms of the effects of the oil price shock on the steel industries of the respective countries, the South American landmass can be effectively divided into two parts. That is, the geographical shape of the region is such that some of the countries profit, while others do not. On the one hand, steel exports to the U.S. either increase (Brazil, Chile, Colombia, Peru) or only decrease marginally (Ecuador) in counties located on the northern coast or on the western coast of the region. On the other hand, the export volumes of countries located on the eastern coast (Argentina, Uruguay) decrease although the decrease is statistically insignificant. Again, the distance of trade is an obvious determining factor. Trade distances between the northern (Brazil: 5,876km; Colombia: 2,763km) and western coast (Chile: 7,756km; Ecuador: 4,104km; Peru: 5,318km) and the United States are shorter when compared with trade distances between countries on the eastern coastline (Argentina: 11,352km; Uruguay: 11,138km) and the United States. Trade distances from Chile to the U.S. are also quite long, but the country seems to compensate the distance effect by its competitiveness which is significantly above South American standards.

6.3.5 Africa

The study includes three African countries, Algeria, Egypt and South Africa.

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to decreasing steel exports for the three African countries. The immediate decline lasts for an average of 2.7 months. Five of the 8 single impulse response values are statistically significant at 68% error bands, a relative share of 62.5%. All statistically significant single impulse response values are negative.

Variance Decomposition Analysis

The explanatory power of the oil price variable for the steel export variable is medium for South Africa and high for Algeria and Egypt.

Comparing the average relative importance of the explanatory variables to the volatility of the steel export variable (oil price: 21.4%; steel import value: 9.3%; exchange rates: 17.8%; U.S. real GDP: 3.2%) shows that the oil price variable has the largest explanatory power of all explanatory variables. To put it differently, the oil price variable explains most of the variation in the steel export variable relative to the other explanatory variables for 2 of 3 African countries analysed.

Granger Causality Analysis

The GC test result confirms the statistical usefulness or the predictive value of the oil price variable for the steel export variable for none of the countries.

Trade Distance Analysis

None of the African countries is landlocked. The shortest steel export trade route to the U.S. is the trade route between the African states and the U.S. East Coast. The average trade distance estimated is 10,353km (calculated on the basis of the shortest trade route between each country and the U.S.). Thereby, trade distances are between 6,907km (Algeria) and 14,627km (South Africa).

The African continent is a net exporter of iron ore (net exports in 2008: 36,263tmt). In this context, South Africa is among the top five iron ore exporters (4.5% of global exports in 2011). Moreover, South Africa (exports in 2011: 1Mt) is among the largest coking coal exporters and Algeria and Egypt produce coking coal domestically. Therefore, the countries analysed are self-sufficient to a certain extent with regard to steelmaking raw materials.

Competitiveness Analysis

The average rank of the three African countries in the GCI of 2008/2009 is position 75 (of 134). Moreover, the average ranks are 63 for overall infrastructure, 74 for port infrastructure, 33 for domestic market size, and 39 for foreign market size. No labour cost data are available for the African countries analysed.

Further Analysis

The average competitiveness of the African countries analysed is below average for most competitive categories. Their overall competitiveness relative to the average competitiveness of the other regions is 8th of 8 (average rank: 75). Moreover, the relative competitiveness of the African countries is 6th of 8 for overall infrastructure (average rank: 63) and port infrastructure (average rank: 74), 3rd of 8 for domestic market size (average rank: 33), and 5th of 8 for foreign market size (average rank: 39).

Steel export volumes to the U.S. decrease for all African countries surveyed in reaction to a one-standard deviation oil price shock. The average length of the downturn is 2.7 months. Thereby, 5 of 8 or 62.5% of the impulse response values (the impulse response values are all negative) are statistically significant which is above the average of 34.5%.

The African countries analysed produce the main steelmaking raw materials domestically to a certain extent (Algeria, Egypt) or are self-sufficient (South Africa). The calculated downstream trade differences for steel exports to the U.S. are quite different for Algeria (6,907km), Egypt (9,526km), and South Africa (14,627km) so that using the average (10,353km) for interpretation purposes would be misleading. However, as a tendency, the longer the downstream trade distances for the African countries, the stronger the downturn of steel exports to the United States. While the impact on the Algerian steel industry is weakest, the impact on the South African steel industry is strongest. Thereby, the downturn is at least partially statistically significant for all countries.

6.3.6 Middle East

The study includes 4 countries from the Middle East, Israel, Saudi Arabia, Turkey and the United Arab Emirates.

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to decreasing steel exports to the U.S. in 3 of the 4 Middle Eastern countries surveyed and to increasing steel exports in 1 country (UAE). The immediate average decline for the countries analysed lasts for an average of 2 months. The average decline for the 3 countries with declining export figures is 3.3 months. The average increase of the UAE’s steel exports lasts for 2 months. Seven of the

12 single impulse response values included in the analysis are statistically significant (68% error bands: 3; 90% error bands: 1; 95% error bands: 3), a relative share of 58.3%. Thereby, all statistically significant impulse response values can be attributed to countries with decreasing steel export figures.

Variance Decomposition Analysis

The explanatory power of the oil price variable for the steel export variable is medium for 3 countries and very high for 1 country (Turkey). The average relative importance for the 4 countries is 19.9% (medium), 22.3% (high) for the 3 countries with decreasing export figures, and 12.7% (medium) for the UAE.

Comparing the average relative importance of the explanatory variables to the volatility of the steel export variable (oil price: 19.9 %; steel import value: 14.4%; exchange rates: 10.7%; U.S. real GDP: 9.3%) shows that the oil price variable has the largest explanatory power of all explanatory variables. To put it differently, the oil price variable explains most of the variation in the steel export variable relative to the other explanatory variables for 2 of 4 countries analysed.

Granger Causality Analysis

The GC test result confirms the statistical usefulness or the predictive value of the oil price variable for the steel export variable for 1 of 4 countries at the 1% level, a relative share of 25%.

Trade Distance Analysis

None of the 4 Middle Eastern countries surveyed is landlocked. The shortest steel export trade route to the U.S. is the trade route between the Middle Eastern nations and the U.S. East Coast. The average trade distance between the region and the U.S. is 11,479km (calculated on the basis of the shortest trade route between each country and the U.S.). Thereby, the trade distances are between 9,567km (Turkey) and 15,316km (UAE).

The region is a net importer of iron ore (net imports in 2008: 21,946tmt). While no Middle Eastern country is among the main coking coal exporters, Turkey is one of the main importers of coking coal (imports in 2011: 4.6Mt). Apart from Turkey, none of the Middle Eastern countries surveyed produces coking coal domestically. Summing up, the region needs to import steelmaking raw materials to a large extent which involves long upstream trade distances.

Competitiveness Analysis

The average rank of the 4 countries in the GCI of 2008/2009 is position 36 (of 134). Moreover, the average ranks are 40 for overall infrastructure, 60 for port infrastructure, 35 for domestic market size, and 33 for foreign market size. Labour cost data are only available for Israel which has a comparative advantage over the U.S. in all labour cost categories (manufacturing wages: \$12.52 vs. \$21.50; hourly compensation costs primary metal manufacturing: \$13.20 vs. \$31.82; hourly compensation costs fabricated product manufacturing: \$12.38 vs. \$26.15).

Further Analysis

The average competitiveness of the Middle Eastern countries analysed can be described as solid average. The average competitiveness estimated for the 4 countries is 4th of 8 in overall competitiveness (average rank: 36), port infrastructure (average rank: 60) and domestic market size (average rank: 35) and 3rd of 8 in overall infrastructure (average rank: 40) and foreign market size (average rank: 33).

Despite the solid average competitiveness of the countries surveyed, steel exports to the U.S. decrease for 3 of 4 countries following an oil price shock. Thereby, the increase of steel exports from the UAE to the U.S. remains statistically insignificant. The average length of the downturn of steel exports lasts for 2 months. Seven of 12 impulse response values are statistically significant (the significant values are all negative) which is a relative share of 58.3%. The relative share is well above average (34.5%).

Due to the fact that there is virtually no production of coking coal or iron ore in the region, the most significant steelmaking raw materials need to be imported to a large extent from distant countries such as Australia or Brazil, which involves very long distance trade. In addition, the calculated average downstream trade distance from the Middle Eastern countries to the U.S. is 11,479km and therefore 28.9% above average (8,164km). Again, the interplay of long trade distances and rising oil prices explains the estimated downturn of steel exports from the region to the U.S. to a significant extent.

6.3.7 Asia

The study includes 11 Asian countries. The VEC model estimates (IRF, VD, GC), the upstream and downstream steel trade distances, and the competitiveness rankings for those countries can be summarised as follows:

Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to decreasing steel exports to the U.S. in 8 of the 11 Asian countries surveyed and to increasing steel exports in 3 countries.

The immediate decline for the Asian countries lasts for an average of 2.7 months. The average decline for the 8 countries with declining export figures is 3.4 months while the average for the 3 countries (Malaysia, Philippines, Singapore) with increasing export figures is 1 month. Of the 30 single impulse values included in the analysis, 5 are statistically significant (68% error bands: 4; 90% error bands: 1), a relative share of 16.7%. Thereby, all statistically significant single impulse response values can be attributed to countries with decreasing steel export figures.

Variance Decomposition Analysis

The explanatory power of the oil price variable for the steel export variable is very low for 1 country, low for 6 countries, medium for 2 countries, high for 2 countries, and very high for none of the countries. The average relative importance of the oil price variable for the steel export variable of the 11 countries is 12% (medium), 13.3% (medium) for the 8 countries with decreasing export figures, and 8.4% (low) for the 3 countries with increasing export figures.

Comparing the average relative importance of the explanatory variables to the volatility of the steel export variable (oil price: 12 %; steel import value: 10.4%; exchange rates: 8.4%; U.S. real GDP: 6.4%) shows that the oil price variable has the largest explanatory power of all explanatory variables. To put it differently, the oil price variable explains most of the variation in the steel export variable relative to the other explanatory variables for 4 of 11 or 36.4% of the Asian countries analysed.

Granger Causality Analysis

The GC test result confirms the statistical usefulness or the predictive value of the oil price variable for the steel export variable for 4 of 11 countries, (1% level: 1; 5% level: 1; 10% level: 2), a relative share of 36.4%.

Trade Distance Analysis

None of the 11 countries surveyed is landlocked. The shortest steel export trade route to the U.S. for 10 of the countries is the trade route between Asia and the U.S. West Coast. In one case (India), the shortest trade route is between the Indian subcontinent and the U.S. East Coast. The average trade distance between Asia and the U.S. is 13,092km (calculated on the basis of the shortest trade route between each country and the U.S.). Thereby, the trade distances for Asian countries are between 9,524km (Japan) and 15,516km (India).

Asia is a significant net importer of iron ore. Although India is among the top five iron ore exporters worldwide, Asian iron ore net imports were at 555,766tmt in 2008. Regarding coking coal, no net import/export figures can be calculated due to a lack of data availability.

However, while Mongolia is one of the main coking coal exporters (20Mt in 2011), China (38Mt in 2011), India (19Mt in 2011), Japan (54Mt in 2011), South Korea (32Mt in 2011), and Taiwan (4Mt in 2011) are among the main coking coal importers. Therefore, it can be assumed that significant upstream trade distances are involved when supplying Asian countries with iron ore and coking coal to meet their demand.

Competitiveness Analysis

The average rank of the countries from the region surveyed in the GCI of 2008/2009 is position 29 (of 134). Moreover, the average ranks are 42 for overall infrastructure, 45 for port infrastructure, 22 for domestic market size, and 14 for foreign market size.

Labour cost data are only published for some of the countries surveyed. The manufacturing wages available (China: $1.06; India: $1.17; Japan: $13.45; Philippines: $1.19; Singapore: $10.45) are well below U.S. standards ($21.50). The same accounts for hourly compensation costs in the primary metal manufacturing sector (U.S.: $31.82 vs. Philippines: $1.66, South Korea: $21.40, Taiwan: $10.69) with the exception of Japan ($32.41) and for hourly compensation costs in the fabricated product manufacturing sector (U.S.: $26.15 vs. Japan: $20.83, Philippines: $1.16, Singapore: $12.17, South Korea: $14.35, Taiwan: $6.28).

Further Analysis

On average, Asian economies are quite competitive by international standards. Comparing the average economic competitiveness of the Asian countries analysed with the average competitiveness of other regions shows that Asia is 3rd of 8 in overall competitiveness (average rank: 29) slightly behind Europe (average rank: 28), 4th in terms of overall infrastructure (average rank: 42), 3rd in port infrastructure (average rank: 45), and 1st in domestic (average rank: 22) and foreign market size (average rank: 14).

Despite Asia's competitiveness, steel exports from Asia to the U.S. decrease for 8 of 11 countries analysed. At first glance, the average decline of Asian exports to the U.S. is equal to the average decline of the European countries included in the analysis. On average, exports to the U.S. decline for 2.7 months in both regions. However, while about one third or 36.3% of the single impulse response values are statistically significant (27 of 29 significant values are negative) in case of Europe, only one sixth or 16.7% of the impulse response values are statistically significant (all statistically significant impulse values are negative) in case of Asia. Moreover, the relative share of volatility in the steel export variable that can be attributed to the volatility in the oil price variable is lower for Asia than for Europe (12% vs. 17.1%).

Thereby, the average distance of trade between the Asian countries and the U.S. is significantly longer than the average trade distance between European countries and the

United States. While the average steel trade distance calculated is 6,805km for Europe, it is 13,092km for Asia, which is a relative difference of 48%. Furthermore, Asia also depends on iron ore and coking coal imports from other regions which implicates long upstream trade distances/transport costs.

The difference in the relative share of statistically significant impulse response values and the relative volatility in the steel export variable that can be attributed to variation in the oil price variable may be due to the following reasons: First, the labour cost structure of most Asian countries is below the labour cost structure of most European countries. For example, industrialised Japan's labour cost structure is well below that of France (manufacturing wages: $13.45 vs. $20.30; hourly compensation costs primary metal manufacturing: $32.41 vs. $42.31; hourly compensation costs fabricated product manufacturing: $20.83 vs. $33.26). Other industrialised European countries such as Austria, Belgium, Finland, Germany or Sweden face similar comparative disadvantages in terms of labour costs when compared to industrialised Asian countries such as Japan, Singapore, or South Korea. Second, none of the Asian countries analysed is landlocked contrary to a number of European countries which face additional transport costs for relatively cost intensive overland transport.

Although European steel industries seem to be relatively more impacted by an oil price shock than Asian steel industries, steel exports also decline for the majority of Asian countries analysed. The increase of exports in the 3 Asian countries (Malaysia, Philippines, Singapore), however remains short and statistically insignificant. It is noteworthy and quite surprising that the steel industries of the largest Asian economies, China and India, are among the Asian countries that are most affected by a shock in oil prices.

6.3.8 Oceania

The Study includes two countries from Oceania, Australia and New Zealand.

<u>Impulse Response Analysis</u>

A one-standard deviation shock to the real oil price leads to decreasing steel exports to the U.S. for both countries. The immediate decline lasts for an average of 1.5 months. Two of the three single impulse response values included in the analysis are statistically significant (68% error bands: 1; 90% error bands: 1), a relative share of 66.7%.

<u>Variance Decomposition Analysis</u>

The explanatory power of the oil price variable for the steel export variable is rather low for New Zealand and very high for Australia.

Comparing the average relative importance of the explanatory variables to the volatility of the steel export variable (oil price: 25.5 %; steel import value: 6.6%; exchange rates: 3.8%;

U.S. real GDP: 5.1%) shows that the oil price variable has the largest explanatory power of all explanatory variables. To put it differently, the oil price variable explains most of the variation in the steel export variable relative to the other explanatory variables for both Oceanian countries analysed.

Granger Causality Analysis

There is no Granger causality for for Australia and New Zealand.

Trade Distance Analysis

Australia and New Zealand are not landlocked. The shortest steel export trade routes to the U.S. for both countries are the trade routes between Oceania and the U.S. West Coast. The average trade distance between Oceania and the U.S. is 13,050km (calculated on the basis of the shortest trade route between each country and the U.S.). Thereby, the trade distance is somewhat shorter for New Zealand (12,169km) than for Australia (13,930km).

Oceania is the largest iron ore net exporting region (net exports in 2008: 304,782tst) mainly due to Australia which is the most significant iron ore exporter worldwide (38% of global iron ore exports in 2011). Additionally, Australia is also the largest coking coal exporter worldwide (140Mt in 2011) while New Zealand is among the largest exporters of coking coal (2.1Mt in 2011). Therefore, Oceania is resource abundant with regard to the two main steel making raw materials.

Competitiveness Analysis

The average rank of the countries from the region surveyed in the GCI of 2008/2009 is position 29 (of 134). Moreover, the average ranks are 42 for overall infrastructure, 45 for port infrastructure, 22 for domestic market size, and 14 for foreign market size.

Australia's labour cost structure is similar to that of the United States. New Zealand has a moderate competitive edge over the U.S. in terms of manufacturing wages ($15.95 vs. $21.50).

Further Analysis

The average competitiveness of the two Oceanian countries is 5th of 8 for domestic market size (average rank: 37), 6th of 8 in foreign market size (average rank: 53), and 1st of 8 in overall competitiveness (average rank: 21), overall infrastructure (average rank: 38), and port infrastructure (average rank: 32).

Steel export volumes to the U.S. decrease for both Australia and New Zealand following a one-standard deviation oil price shock. The average length of the downturn lasts for 1.5 months. Thereby, two thirds or 2 of 3 impulse response values are statistically significant which is well above the average of 34.5% and the highest relative share for all regions. In addition, the average relative share of the volatility in the steel export variable that can be explained by variations in the oil price variable is the largest of all regions (25.5%) and well above average (16.1%).

Both Australia and New Zealand are self-sufficient with regard to the main steel making raw materials and therefore have a comparative advantage because their steel industries are not affected by upstream trade distance costs from distant countries. However, the average steel trade distance calculated for both countries (13,050km) is only marginally lower than the average calculated for Asia (13,092km) which faces the longest average downstream trade distance of all regions. The average trade distance for Oceania is 37.4% above the average of 8,164km. When compared to Asia (-2.7 months), the average decrease in steel exports (-1.5 months) is somewhat shorter which may be due to the regions self-sufficiency in steelmaking raw materials.

Summing up, the evidence suggests that the interplay between rising oil prices and very long distance trade is an important determinant of steel export volumes from Oceania to the United States.

6.3.9 Conclusion

Tables 6.21-6.24 summarise the main evaluation criteria used in the analysis in section 6.3. Table 6.22 shows the average position of the regions in the competitiveness rankings. As already described above, these averages have been calculated based on the rankings of the countries from each region which have been included in the analysis by steel export country (see 6.2).

Table 6.22 Average Competitiveness of Regions

Region	Ø GCI	Ø Overall Infrastructure	Ø Port Infrastructure	Ø Domestic Market Size	Ø Foreign Market Size
Europe	28	39	40	41	37
C:I.S.	63	78	88	30	31
North America	69	62	66	67	70
South America	74	83	92	43	54
Africa	75	63	74	33	39
Middle East	36	40	60	35	33
Asia	29	42	45	22	14
Oceania	21	38	32	37	53

Source: Author's calculations; Schwab and Porter 2008

Table 6.23 gives an overview of the number of landlocked and non-landlocked countries for each region. It turns out that 57 of the 64 most significant steel exporters to the U.S. are not landlocked. This indicates the burden of being landlocked for international trade.

Table 6.23 Landlocked and Non-landlocked Countries per Region

Region	Number of Countries	Landlocked	Non-landlocked
Europe	25	6	19
C.I.S.	3	1	2
North America	9	0	9
South America	7	0	7
Africa	3	0	3
Middle East	4	0	4
Asia	11	0	11
Oceania	2	0	2
Total	64	7	57

Source: Author's calculations

Table 6.24 shows the number of countries included for each region, the number of countries where steel exports to the U.S. increase/decrease following a one-standard deviation oil price shock, and the average length of the increase/decrease for each region. On average, steel exports to the U.S. increase for North and South America and decrease for Africa, Asia, the C.I.S., Europe, the Middle East, and Oceania. Thereby, it becomes evident that the distance of trade is a significant determinant of trade patterns in the global steel industry and that the industry's trade patterns shift following a shock in real oil prices.

Table 6.24 Increasing Exports vs. Decreasing Exports by Region

Region	Number of Countries	Countries with Increasing Export Figures	Countries with Decreasing Export Figures	Average of Impulse Response Estimates (in months)
Europe	25	4	21	-2.7
C.I.S.	3	0	3	-4.3
North America	9	9	0	3.9
South America	7	4	3	0.7
Africa	3	0	3	-2.7
Middle East	4	1	3	-2.0
Asia	11	3	8	-2.7
Oceania	2	0	2	-1.5

Source: Author's calculations

Table 6.25 shows the average steel trade distance with the U.S. for each region, the minimal/maximal trade distance calculated for the countries from each region, and the nearest U.S. coast(s) for each region.

Table 6.25 Steel Trade Distances to the U.S. (in km)

	Ø Trade Distance	min./max. Trade Distance	"nearest" U.S. Coasts
Europe	6,805	5,672 - 9,919	East Coast (19x)
C.I.S.	9,121	8,100 - 10,141	East Coast (2x)
North America	2,492	1,140 - 4,054	East Coast (2x), Gulf Coast (6x), West Coast (1x)
South America	6,901	2,763 - 11,352	East Coast (3x), Gulf Coast (4x)
Africa	10,353	6,907 - 14,627	East Coast (3x)
Middle East	11,479	9,567 - 15,316	East Coast (4x)
Asia	13,092	9,524 - 15,516	East Coast (1x), West Coast (10x)
Oceania	13,050	12,169 - 13,930	West Coast (2x)
Average	8,164	1,140 - 15,516	East Coast (34x), Gulf Coast (10x), West Coast (13x)

Source: Author's calculations (vesseltracker.com, Port Distance Calculator)

The North American countries profit from the lowest average trade distance with the U.S. (average trade distance: 2,492km; average increase of steel exports: 3.9 months). South American exports to the U.S. also increase, albeit at a lower level (0.7 months). The average South American trade distance (6,901km) is below the average of 8,164km. However, if one calculates the average trade distance for South American countries whose steel industries profit (Brazil, Chile, Colombia, Peru)/are adversely affected (Argentina, Peru, Uruguay) by the oil price shock, the importance of distance becomes even clearer. While the trade distance for those countries which profit is well below the average trade distance (5,428km vs. 8.164km), the trade distance of the countries whose industries are adversely affected is above average (8,864km vs. 8.164km).

Average calculated trade distances for the adversely affected regions are well above the average trade distance with the exception of Europe (6,805km) where factors other than distance also contribute to the average decline of 2.7 months (see 6.3.1.3).

Finally, table 6.26 shows the average explanatory power of the explanatory variables for the steel export variable for the countries from each region and table 6.27 shows the number of countries in each region where the oil price variable explains the largest (rank 1), second-largest (rank 2) , third-largest (rank 3) and fourth-largest (rank 4) share of variation in the steel export variable in relation to the other explanatory variables.

Table 6.26 Average Explanatory Power of the Explanatory Variables (in%)

	OIL	VALUE	EXRA	RGDP
Europe	17.9	11.6	8.7	7.0
C.I.S.	26.9	7.8	8.4	14.1
North America	14.4	12.4	10.6	6.5
South America	11.8	11.5	6.8	2.9
Africa	21.4	9.3	17.8	3.2
Middle East	19.9	14.4	10.7	9.3
Asia	12.0	10.4	8.4	6.4
Oceania	25.5	6.6	3.8	5.1

Source: Author's calculations

Table 6.27 Ranks of the Oil Price Variable

	Rank 1		Rank 2		Rank 3		Rank 4	
	abs.	in %	abs.	in %	abs.	in %	abs.	in %
Europe	14	56.0	9	36.0	1	4.0	1	4.0
C.I.S.	2	66.7	1	33.3	-	-	-	-
North America	4	44.4	4	44.4	1	11.1	-	-
South America	3	42.9	1	14.2	3	42.9	-	-
Africa	2	66.7	1	33.3	-	-	-	-
Middle East	2	50.0	2	50.0	-	-	-	-
Asia	4	36.4	4	36.4	2	18.2	1	9.1
Oceania	2	100.0	-	-	-	-	-	-
Total	33	51.6	22	34.4	7	10.9	2	3.1

Source: Author's calculations

It turns out that the oil price variable accounts for most of the variation in the steel export variable for all regions analysed. Thereby, the average explanatory power of the oil price variable for each region is either moderate (Europe, North America, South America, Middle East, Asia) or high (C.I.S., Africa).

6.4 Analysis of Steel Exports to the U.S. by Category

After the analysis of the econometric estimates by exporting country (see 6.2) and region (see 6.3), the estimates for steel product categories for 18 selected countries exporting steel to the U.S. are analysed. The countries and steel categories chosen and the analytic procedure applied are described first (6.4.1) followed by the analysis of the selected countries (6.4.2 – 6.4.9). Finally, the findings from the analysis are summarised (6.4.10).

6.4.1 Selected Countries/Steel Product Categories and Analytic Procedure

Section 6.4.1 first describes the countries and steel categories analysed (6.4.1.1) and then describes the analytic procedure applied (6.4.1.2)

6.4.1.1 Selected Countries and Steel Product Categories

Among the 18 countries selected for analysis by steel export category are 14 of the top 15 steel exporting countries[88] in 2008 (World Steel Association 2010, see table 6.28). Additionally, Canada (7,440tmt), Mexico (5,993tmt), South Africa (2,188tmt) and Australia (1,421tmt) have been selected. Therefore, at least one country from each world region has been included in the analysis by category (see table 6.29). In 2008, the 18 countries selected accounted for 75.8% of global steel exports.

Export volumes to the U.S. are analysed for the 36 steel product categories listed in table 6.30.

Table 6.28 Top Steel Exporters 2008

Country	Steel Exports (in TMT)
China	56,304
Japan	36,923
Ukraine	28,648
Germany	28,639
Russia	28,429
Belgium	21,235
South Korea	19,718
Turkey	18,535
Italy	18,040
France	17,125
United States (excluded)	*11,963*
Taiwan	10,038
Netherlands	10,029
Spain	9,456
Brazil	9,152

Source: World Steel Association 2010

Table 6.29 Selected Steel Exporting Countries

Region	Selected Countries
Europe	Belgium, France, Germany, Italy, Netherlands, Spain
C.I.S.	Russia, Ukraine
North America	Canada, Mexico
South America	Brazil
Africa	South Africa
Middle East	Turkey
Asia	China, Japan, South Korea, Taiwan
Oceania	Australia

Table 6.30 Steel Product Categories

Ref.-Code	Category	Average Unit Price (in U.S. $)	Ref.-Code	Category	Average Unit Price (in U.S. $)
1A	Ingots And Steel For Castings	1,555	21A	Mechanical Tubing	1,000
1B	Blooms, Billets and Slabs	392	21B	Pressure Tubing	1,560
3	Wire Rods	444	21CD	Stainless Pipe & Tubing	4,744
4	Structural Shapes Heavy	516	21E	Pipe & Tubing Nonclassified	2,109
5	Steel Piling	719	22A	Structural Pipe & Tube	685
6A	Plate Cut Lengths	757	22B	Pipe For Piling	640
6B	Plates In Coils	509	23	Wire Drawn	1,015
7	Rails Standard	581	28	Black Plate	665
8	Rails All Other	660	29	Tin Plate	651
9	Railroad Accessories	722	29A	Tin Free Steel	714
14	Bars – Hot Rolled	647	31	Sheets Hot Rolled	426
14A	Bars – Light Shaped	598	32	Sheets Cold Rolled	812
15	Bars – Reinforcing	365	33A	Sheets & Strips Galv Hot Dipped	635
16	Bars – Cold Finished	1,565	33B	Sheets & Strips Galv Electrolyt	690
17	Tool Steel	1,853	34	Sheets & Strips All Other Metal	787
18	Standard Pipe	640	35	Sheets & Strips – Electrical	1,072
19	Oil Country Goods	922	36	Strip –Hot Rolled	625
20/20A-C*	Line Pipe	731	37	Strip –Cold Rolled	1,920

*20	Line Pipe until December 2000
20A	Line Pipe > 16 Inches In Diameter; from January 2001
20B	Line Pipe ≤ 16 Inches In Diameter; from January 2001
20C	Line Pipe – Not Specified; from January 2001

Source: U.S. Census 2007

6.4.1.2 Analytic Procedure

The analytic procedure applied for each steel exporting country is as follows:

Analytical Structure

1. Included and Excluded Steel Product Categories
2. Impulse Response Analysis
3. Variance Decomposition Analysis
4. Granger Causality Analysis
5. Price Pattern Analysis
6. Conclusion

1. Included and Excluded Steel Product Categories

The first section reviews how many of the 36 categories listed in table 6.30 have been included in the analysis and then lists the categories that have been excluded. For each excluded category, the reason for the preclusion is described.

2. Impulse Response Analysis

The analysis in the impulse response section addresses the following questions:

1. For how many categories do steel exports increase/decrease following a one-standard deviation oil price shock?

2. What is the average immediate increase/decline of steel exports to the U.S. in reaction to the oil price shock for all categories analysed, for the categories with increasing steel export volumes, and for the categories with decreasing export volumes?
3. How many of the impulse response values are statistically significant? How many positive/negative impulse response values are statistically significant?
4. For how many of the categories are the estimates (at least partially) statistically significant? For how many categories with positive/negative impulse responses are the estimates statistically significant?

3. Variance Decomposition Analysis

The analysis in the variance decomposition section addresses the following questions:
1. What is the average relative share of volatility in the steel export variable that is due to variation in the oil price variable?
2. How large is the relative share of volatility in the steel export variable that can be explained by variation in the oil price variable? How is the explanatory power of the oil price variable for the steel export variable distributed among the single steel product categories? In other words, for how many of the categories is the relative share very low (0% ≤ very low < 5%), low (5% ≤ low < 10%), moderate (10% ≤ moderate < 20%), high (20% ≤ high < 30%), or very high (very high > 30%)?
3. How large is the average explanatory power of the oil price variable for the steel export variable compared to the average explanatory power of the other explanatory variables?

4. Granger Causality Analysis

The analysis in the Granger causality section addresses the following questions:
1. For how many samples analysed does the oil price variable Granger cause the steel export variable at the 1%, 5% or 10% level?
2. What is the relative share of samples where the oil price variable Granger causes the steel export variable?

5. Price Pattern Analysis

In the price pattern analysis section, the steel product categories are split up into low-value and high-value categories to analyse whether the impact of an oil price shock on steel exports to the U.S. is more significant for low-value steel exports than for high-value steel exports.
Economic theory suggests that an oil price shock leads to higher transport costs for all steel exporters to the U.S. irrespective of their geographic location. However, the impact of rising transport costs on exporters grows with increasing trade distance so that remote exporters are

affected overproportionally (Gangnes et al. 2011 a, b; Kousnetzoff et al. 2008; Mirza and Zitouna 2008). As a consequence, steel exporters geographically close to the U.S. should increase their export share at the cost of remote exporters once oil prices/transport costs reach a certain level. Thereby, according to economic theory, for geographically remote exporters the adverse effect of rising transport costs on low-value steel exports should be stronger than the adverse effect on high-value steel exports because the share of transport costs to final selling prices should, by tendency, be larger for low-value steel than for high-value steel. That is, it should be relatively easier for steel exporters geographically close to the U.S to increase their market share at the cost of geographically remote exporters in low-value steel segments than in high-value steel segments.

In order to be able to investigate whether the impact (in a positive sense for geographically close exporters/in a negative sense for geographically remote exporters) of rising transport costs is stronger for low-value steel exports than for high-value steel exports, it is necessary to separate the steel product categories into high- and low-value categories. This classification of steel product categories is based on the average unit price (AUP) per category. The AUPs for the categories have been calculated as follows:

The U.S. Census Bureau publishes AUPs for monthly U.S. steel imports per category (The AUP is calculated by dividing the monthly total U.S. steel import value by the monthly total steel imports in quantity metric tons.). In order to calculate the AUP for the sample period for each category, the monthly AUPs from November 1998 to September 2008 have been summed up. The sum has then been divided by the number of months/observations in the sample period (119 months/observations).

Based on the calculated AUPs, the steel product categories have then been subdivided into two groups, a low-value group, and a high-value group. The low-value group contains steel product categories with an AUP below $1,500. Steel product groups with an AUP above $1,500 were assigned to the high-value product group.

The AUP range in the low-value group is between $365 and $1,072. The group consists of 29 categories. The AUP range in the high-value product group is between $1,555 and $4,744 and consists of 7 categories (see table 6.94). That is, about 80% of the categories have been assigned to the low-value group and about 20% have been assigned to the high-value product group. One can clearly see the gap between the largest AUP in the low-value group and the smallest AUP in the high-value group ($1,072 vs. $1,555). The significant price gap between both groups increases the probability to detect price patterns.

The analysis in the price pattern section addresses the following questions:

1. For how many low-value/high-value steel product categories have significant volumes of steel been exported from the exporting country to the U.S. during the sample period?

Explanation: If the share of product groups where significant volumes of steel have been exported during the sample period from a steel exporting country to the U.S. is relatively larger for the high-value product group than for the low-value product group, this may indicate that it is relatively more profitable to export high-value steel, especially when long trade distances are involved (Of course, the volume of steel exported per category is an additional indicator for the profitableness of exports.).

2. In how many low-value/high-value categories do steel export values increase/decrease following a one-standard deviation shock in the oil price variable?
Explanation: If the relative share of low-value categories for which steel exports from a geographically distant country decrease following an oil price shock is larger than the relative share of high-value categories with negative impulse response estimates, this may suggest that the negative effect of rising oil prices/transport costs is stronger for low-value steel exports than high-value steel products. If the relative share of low-value categories for which steel exports from a geographically proximal country increase following an oil price shock is larger than the relative share of high-value categories with positive impulse response estimates, this may suggest that the positive effect is stronger for low-value steel exports than for high-value exports. This would suggest that countries geographically close to the U.S. can especially increase their market share for low-value steel exports at the cost of more remote exporting countries.

3. How long is the average increase/decrease of steel exports in the low-value/high-value categories following a one-standard deviation shock in the oil price variable?
Explanation: If the average decline of steel exports from a geographically distant country to the U.S. lasts longer for low-value exports than for high-value exports, this may indicate that the adverse effect of the oil price shock is stronger for low-value exports than for high-value exports. If the average increase of steel exports from a geographically close country to the U.S. lasts longer for low-value exports than for high-value exports, this may indicate that geographically proximate countries can especially increase their low-value steel exports at the cost of distant countries.

4. How many of the low-value/high-value impulse response estimates are statistically significant?
Explanation: If the relative share of statistically significant negative impulse response estimates for geographically distant countries is larger for low-value steel exports to the U.S. than for high-value steel exports, this suggests that the negative effect of an oil price shock is stronger for long-distance, low-value exports than for long-distance, high-value exports. If

the relative share of statistically significant positive impulse response estimates for geographically close countries is larger for low-value steel exports to the U.S. than for high-value exports, this may indicate that countries geographically close to the U.S. can especially increase their low-value steel export volumes at the cost of geographically remote countries. This would suggest that low-value steel exports from geographically distant exporting countries are more vulnerable than high-value steel exports.

5. How large is the average relative volatility in the steel export variable that can be attributed to variation in the oil price variable for the low-value/high-value steel product categories?
Explanation: If the average relative volatility in the steel export variable that is due to variation in the oil price variable is larger for low-value exports from geographically distant/close countries than for high-value exports, this may suggest that the impact of the volatility in the oil price variable on the steel export variable is stronger for low-value steel exports than for high-value steel exports.

6. Conclusion
Section 6 summarises the results obtained in sections 1 to 5 and concludes.

6.4.2 Europe

For Europe, Belgium (6.4.2.1), France (6.4.2.2), Germany (6.4.2.3), Italy (6.4.2.4), the Netherlands (6.4.2.5), and Spain (6.4.2.6) have been selected for the analysis of steel exports to the U.S. per steel product category.

6.4.2.1 Belgium

Table 6.31 VEC Analysis - Belgium

Product Category	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
1A	1	-2.235	2.3	0.24
1B	1	877.819 *	9.4	0.56
3	1	-120.333	10.2	0.81
	2	-136.444		
4	1	-2.785	6.4	0.61
	2	-4.444		
	3	-21.143 *		
	4	-5.064		
6A	1	-10.001	18.3	0.18
	2	-275.541 ***		
	3	-60.004		
6B	1	-34.036	16.7	0.73
7	1	-4.193	12.1	0.33
	2	-1.707		
	3	-4.420		
	4	-4.719		
	5	-7.258 **		
	6	-0.748		
	7	-4.439 *		
8	1	-1.714	3.8	0.08
14	1	35.970 *	3.8	0.75
14A	1	-6.908 *	38.9	0.06
15	1	-7.280	9.5	0.80
16	1	-6.596	3.8	0.19
	2	-1.881		
17	1	-2.531	7.2	0.89
	2	-11.368 *		
	3	-5.613		
18	1	13.090	21.5	0.00
19	1	2.660 *	2.6	0.36
20	1	-5.085	3.7	0.18
	2	-1.331		
	3	-7.976 *		
	4	-1.443		

VEC Analysis - Belgium (continued)				
Product Category	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
21A	1	-2.293	4.4	0.47
21B	1	-1.121 *	8.7	0.07
	2	-3.542 ***		
	3	-1.544 *		
21CD	1	-1.372	6.9	0.75
21E	1	1.806	1.0	0.31
	2	1.821		
23	1	-7.155	20.8	0.64
	2	-22.787 *		
28	1	24.398	19.9	0.87
29	1	-116.986 *	12.4	0.55
	2	-48.434		
	3	-124.781 *		
	4	-131.149 *		
29A	1	-4.956	5.5	0.68
	2	-13.462		
	3	-1.995		
	4	-38.045 *		
31	1	-269.513	5.7	0.39
	2	-712.771 *		
	3	-90.958		
32	1	-6.668	4.0	0.78
	2	-988.699		
33A	1	-72.738	10.1	0.17
	2	-168.032 *		
	3	-298.235 ***		
	4	-73.708		
	5	-89.073		
33B	1	-32.697	24.5	0.60
	2	-20.415		
34	1	-19.001	27.8	0.64
	2	-2.586		
35	1	-3.696	10.6	0.69
	2	-11.128 **		
	3	-7.215		
	4	-3.543		
	5	-5.843		
36	1	0.808 *	45.1	0.00
	2	0.521		
37	1	-0.034	44.3	0.00

Source:
Author's calculations (EViews®)

* statistically significant at 68% error bands
** statistically significant at 90% error bands
*** statistically significant at 95% error bands

1. Included and Excluded Steel Product Categories

The steel product category analysis for Belgium includes 32 of 36 categories. Four categories have been excluded from the analysis for the following reasons:

- no exports to the U.S. during the sample period: 9, 22b
- exports to the U.S. during the sample period in less than ten months: 5
- VEC matrix not positive definite: 22a

2. Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to decreasing steel exports from Belgium to the U.S. in 25 of the 32 steel product categories analysed (78.1%) and to increasing exports in 7 of the 32 categories (21.9%).

The average immediate decline for the 32 categories lasts for 1.8 months. The average decline for the 25 categories with decreasing export volumes lasts for 2.6 months and the average increase for the 7 categories with increasing export volumes lasts for 1.3 months.

23 of the 74 impulse response values are statistically significant (relative share: 31.1%), 18 at 68% error bands, 2 at 90% error bands, and 3 at 95% error bands. 19 of the 65 negative impulse response values (relative share: 29.2%) are statistically significant (68% error bands: 14; 90% error bands: 2; 95% error bands: 3) and 4 of the 9 positive impulse response values (relative share: 44.4%) are also statistically significant at 68% error bands. This means that 82.6% of the statistically significant impulse response values are negative.

The impulse response estimates for 17 of 32 categories (relative share: 53.1%) are (at least partially) statistically significant. When discriminating between categories with positive and negative impulse response estimates, 13 of 25 or 52% of the categories with negative estimates are statistically significant while 4 of 7 or 57.1% of the categories with positive estimates are statistically significant. This means that 76.5% of the statistically significant impulse response estimates are negative.

3. Variance Decomposition Analysis

The average relative share of volatility in the steel export variable that is due to variation in the oil price variable is 13.2% (moderate) for all categories included, 12.7% (moderate) for the categories with negative impulse responses, and 14.8% (moderate) for the categories with positive impulse responses.

The average relative variation in the steel export variable that can be explained by variation in the oil price variable is very low for 9 of the 25 categories (28.1%), low for 8 categories (25%), moderate for 8 categories (25%), high for 4 categories (12.5%), and very high for 3 categories (9.4%).

Comparing the average relative importance of the explanatory variables to the volatility of the steel export variable (oil price: 13.2 %; steel import value: 9%; exchange rates: 6.9%; U.S. real GDP: 7%) shows that the oil price variable has the largest explanatory power of all explanatory variables. To put it differently, the oil price variable explains most of the variation in the steel export variable relative to the other explanatory variables for 14 of 32 or 43.8% of the categories analysed.

4. Granger Causality Analysis

The GC test results confirm the statistical usefulness or the predictive value of the oil price variable for the steel export variable for 6 of 32 categories (1% level: 3; 10% level: 3), a relative share of 18.8%.

5. Price Pattern Analysis

During the sample period, Belgium exported significant volumes of steel to the U.S. in 25 of 29 low-value steel product categories (86.2%) and in 7 of 7 high-value categories (100%).
Following a one-standard deviation oil price shock, steel exports to the U.S. decrease in 19 of 25 low-value steel product categories (76%) and in 6 of 7 high-value categories (85.7%).
On average, exports in low-value steel product categories decrease for 1.9 months and exports in high-value categories decline for 1.3 months.
The impulse response estimates are statistically significant for 15 of 25 low-value steel product categories (60%) and for 2 of 7 high-value categories (28.6%)
The average relative volatility in the steel export variable that can be explained by variation in the oil price variable is 13.9% (moderate) for the low-value categories and 10.6% (moderate) for the high-value categories.

6. Conclusion

Impulse Responses and Variance Decomposition

A one-standard deviation shock in the oil price variable leads to decreasing export volumes from Belgium to the U.S. for 78.1% of the categories analysed. On average, steel exports to the U.S. decline for 1.8 months. When it comes to the relative share of positive and negative statistically significant impulse response values, 82.6% of the statistically significant values are negative. Moreover, 76.5% of the statistically significant impulse response estimates are also negative.
For the categories analysed, the average relative variation in the steel export variable that can be attributed to volatility in the oil price variable is moderate (25%), high (12.5%), or very high (9.4%) for a strong minority of the categories analysed (46.9%) and serves as an indicator for the significant explanatory power of the oil price variable for the steel export

variable. Thereby, the average share of volatility in the steel export variable that is due to variation in the oil price variable is 13.2% (moderate) for all categories analysed.

Summing up, there is strong evidence that Belgian steel exports to the U.S. are negatively impacted by an oil price shock. By tendency, the results are in line with the findings for total Belgian steel exports to the U.S. in section 6.2.1.2. Moreover, the variance decomposition estimates provide evidence for the explanatory power oil prices can have for steel trade volumes.

Price Patterns

The following findings provide evidence for the hypothesis that oil price shocks have a stronger impact on low-value steel trade than on high-value steel trade:

- The relative share of steel product categories for which significant volumes of steel have been exported from Belgium to the U.S. during the sample period is larger for high-value exports (100%) than for low-value exports (86.2%).
- The average decline of steel exports from Belgium to the U.S. lasts longer for low-value exports (1.9 months) than for high-value exports (1.3 months).
- The relative share of statistically significant impulse response estimates is higher for low-value categories (60%) than for high-value categories (28.6%). This might indicate that low-value exports to the U.S. are more affected by oil price shocks than high-value exports.
- On average, the explanatory power of the oil price variable for the steel export variable is higher for low-value categories (13.9%) than for high-value categories (10.6%) which might indicate that low-value categories are relatively more affected by oil price shocks.

The following findings provide evidence against the hypothesis:

- While export volumes from Belgium to the U.S. decline for 85.7% of the high-value categories, export volumes decline for only 76% of the low-value categories.

The majority of the estimates indicate that low-value steel exports from Belgium to the U.S. are more affected by oil price shocks than high-value exports.

6.4.2.2 France

Table 6.32 VEC Analysis - France

Product Category	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
1B	1	-86.946	27.7	0.04
	2	-430.454 **		
	3	-129.767		
	4	-425.333 *		
	5	-150.403		
	6	-176.278		
3	1	-274.318 *	37.5	0.34
	2	-139.117		
4	1	-4.446	14.7	0.51
6A	1	-39.872	3.4	0.39
	2	-28.751		
6B	1	-374.960 *	5.3	0.25
	2	-279.912		
	3	-118.654		
	4	-58.253		
7	1	236.709 *	12.6	0.69
	2	53.949		
14	1	-12.914	24.0	0.29
14A	1	-0.090	11.0	0.60
	2	-1.235 ***		
	3	-0.520		
	4	-1.202 **		
	5	-0.114		
16	1	50.234	1.7	< 0.10
17	1	-74.519 *	7.0	0.79
	2	-8.023		
	3	-35.757		
	4	-19.977		
18	1	-27.084 *	4.3	0.04
	2	-6.580		
19	1	113.775	4.7	0.76
	2	113.187		
20	1	178.083 *	16.3	0.36
21A	1	-15.459	14.2	0.69
	2	-34.204		
	3	-10.233		
	4	-41.694 *		
	5	-47.684 *		

VEC Analysis - France (continued)				
Product Category	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
21B	1	7.113	7.0	0.93
21CD	1	-15.565	23.1	0.24
	2	-11.288		
21E	1	-0.504 *	22.8	0.00
	2	-0.072		
	3	-0.374 *		
	4	-0.626 **		
22A	1	-1.897	4.3	0.23
	2	-8.031		
23	1	-13.644	10.3	0.89
28	1	54.394 *	9.5	0.00
	2	45.505		
	3	11.915		
	4	13.467		
29	1	-145.098	22.3	0.42
	2	-188.784 *		
29A	1	-21.289	26.2	0.51
	2	-94.655		
31	1	-1,094.911 *	4.6	0.74
32	1	-204.371	12.9	0.89
	2	-76.173		
	3	-34.588		
	4	-295.593 **		
	5	-200.636		
	6	-142.919		
	7	-1.596		
33A	1	-38.766	23.1	0.00
	2	-36.316		
34	1	7.317	12.2	0.97
35	1	12.263	5.9	0.52
	2	56.364 ***		
	3	22.337		
	4	13.778		
36	1	3.840	3.3	0.38
37	1	-6.702	4.2	0.85

Source:
Author's calculations (EViews®)

* statistically significant at 68% error bands
** statistically significant at 90% error bands
*** statistically significant at 95% error bands

1. Included and Excluded Steel Product Categories

The steel product category analysis for France includes 29 of 36 categories. Seven categories have been excluded from the analysis for the following reasons:

- no exports to the U.S. during the sample period: 9
- exports to the U.S. during the sample period in less than ten months: 1a, 5, 15, 22b, 33b
- VEC matrix not positive definite: 8

2. Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to decreasing steel exports from France to the U.S. in 20 of the 29 product categories analysed (69%) and to increasing exports in 9 categories (31%).

The average immediate decline for the 29 categories lasts for 1.3 months. The average decline for the 20 categories with decreasing export volumes lasts for 2.8 months while the average increase for the 9 categories with increasing export volumes lasts for 2.1 months.

20 of the 75 single impulse response values are statistically significant (relative share: 26.7%), 15 at 68% error bands, 3 at 90% error bands, and 2 at 95% error bands. 16 of the 56 negative impulse response values (relative share: 28.6%) are statistically significant (68% error bands: 12; 90% error bands: 3; 95% error bands: 1) and 4 of the 19 positive impulse response values (relative share: 21.1%) are also statistically significant (68% error bands: 3; 95% error bands: 1). This means that 80% of the statistically significant impulse response values are negative.

The impulse response estimates for 15 of 29 categories (relative share: 51.7%) are (at least partially) statistically significant. When discriminating between categories with positive and negative impulse response estimates, 11 of 20 or 55% of the categories with negative estimates are statistically significant while 4 of 9 or 44.4% of the categories with positive estimates are also statistically significant. This means that 73.3% of the statistically significant impulse response estimates are negative.

3. Variance Decomposition Analysis

The average relative share of volatility in the steel export variable that is due to variation in the oil price variable is 13% (moderate) for all categories included, 15.1% (moderate) for the categories with negative impulse responses, and 8.1% (low) for the categories with positive impulse responses.

The average relative variation in the steel export variable that can be explained by variation in the oil price variable is very low for 8 of the 29 categories (27.6%), low for 5 categories

(17.2%), moderate for 8 categories (27.6%), high for 7 categories (24.1%), and very high for 1 category (3.4%).

Comparing the average relative importance of the explanatory variables to the volatility of the steel export variable (oil price: 13%; steel import value: 9.1%; exchange rates: 6.7%; U.S. real GDP: 7%) shows that the oil price variable has the largest explanatory power of all explanatory variables. To put it differently, the oil price variable explains most of the variation in the steel export variable relative to the other explanatory variables for 15 of 29 or 51.7% of the categories analysed.

4. Granger Causality Analysis

The GC test results confirm the statistical usefulness or the predictive value of the oil price variable for the steel export variable for 6 of 29 categories (1% level: 3; 5% level: 2; 10% level: 1), a relative share of 20.7%.

5. Price Pattern Analysis

During the sample period, France exported significant volumes of steel to the U.S. in 23 of 29 low-value steel product categories (79.3%) and in 6 of 7 high-value categories (85.7%).

Following a one-standard deviation oil price shock, steel exports to the U.S. decrease in 16 of 23 low-value steel product categories (69.6%) and in 4 of 6 high value categories (66.7%). On average, exports in low-value steel product categories decrease for 1.3 months and exports in high-value categories decline for 1.5 months.

The impulse response estimates are statistically significant for 13 of 23 low-value steel product categories (56.5%) and for 2 of 6 high-value categories (33.3%)

The average relative volatility in the steel export variable that can be explained by variation in the oil price variable is 13.5% (moderate) for the low-value categories and 11% (moderate) for the high-value categories.

6. Conclusion

Impulse Responses and Variance Decomposition

A one-standard deviation shock in the oil price variable leads to decreasing export volumes from France to the U.S. for 69% of the categories analysed. On average, steel exports to the U.S. decline for 1.3 months. When it comes to the relative share of positive and negative statistically significant impulse response values, 80% of the statistically significant values are negative. Moreover, 73.3% of the statistically significant impulse response estimates are negative.

For the categories analysed, the average relative variation in the steel export variable that can be attributed to volatility in the oil price variable is moderate (27.6%), high (24.1%), or very

high (3.4%) for the majority of the categories analysed (55.1%) which serves as an indicator for the significant explanatory power of the oil price variable for the steel export variable. Thereby, the average share of volatility in the steel export variable that is due to variation in the oil price variable for all categories analysed is 13% (moderate).
Summing up, there is evidence that French steel exports to the U.S. are negatively impacted by an oil price shock. The results are in line with the findings for total French steel exports to the U.S. in section 6.2.1.8. Moreover, the variance decomposition estimates provide evidence for the explanatory power oil prices can have for steel trade volumes.

Price Patterns

The following findings provide evidence for the hypothesis that oil price shocks have a stronger impact on low-value steel trade than on high-value steel trade:

- The relative share of steel product categories for which significant volumes of steel have been exported from France to the U.S. during the sample period is larger for high-value exports (85.7%) than for low-value exports (79.3%).
- While export volumes from France to the U.S. decline for 69.6% of the low-value categories, export volumes decline for only 66.7% of high-value categories.
- The relative share of statistically significant impulse response estimates is higher for low-value categories (56.5%) than for high-value categories (33.3%). This might indicate that low-value exports to the U.S. are more affected by oil price shocks than high-value exports.
- On average, the explanatory power of the oil price variable for the steel export variable is higher for low-value categories (13.5%) than for high-value categories (11%) which might indicate that low-value categories are relatively more affected by oil price shocks.

The following findings provide evidence against the hypothesis:

- The average decline of steel exports from France to the U.S. lasts longer for high-value exports (1.5 months) than for low-value exports (1.3 months).

The majority of the estimates indicate that low-value steel exports from France to the U.S. are more affected by oil price shocks than high-value exports.

6.4.2.3 Germany

Table 6.33 VEC Analysis - Germany

Product Category	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
1A	1	-12.434	14.7	0.15
	2	-10.422		
1B	1	-1,443.896 *	30.8	0.64
3	1	425.467	4.6	0.61
	2	822.027		
4	1	-412.130 *	25.6	0.06
	2	-51.049		
5	1	-10.821	12.5	0.16
6A	1	-125.452	4.6	0.37
6B	1	-579.659 ***	12.9	0.72
	2	-107.729		
	3	-362.957 *		
	4	-223.947		
	5	-194.442		
7	1	-5.153	14.9	0.00
	2	-9.788		
	3	-22.724		
	4	-55.701 *		
	5	-44.572		
	6	-75.622 *		
	7	-33.145		
	8	-78.001 *		
	9	-46.950		
	10	-7.694		
8	1	-4.652	5.9	0.30
9	1	-5.252 *	17.6	0.59
14	1	-115.294	28.1	0.72
14A	1	16.367	9.6	0.13
15	1	243.360	5.3	0.36
16	1	-90.611 *	58.0	0.49
	2	-87.353 *		
	3	-60.864		
	4	-9.945		
	5	-23.146		

VEC Analysis - Germany (continued)				
Product Category	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
17	1	-21.090	17.5	0.14
	2	-64.993 *		
	3	-162.250 ***		
	4	-71.133 *		
	5	-79.773 *		
	6	-30.676		
	7	-14.527		
	8	-10.403		
18	1	-39.001	1.8	0.19
	2	-0.878		
	3	-9.890		
19	1	-51.301	7.2	0.74
20	1	-541.053	14.2	0.00
	2	-515.989		
	3	-192.460		
	4	-2,366.176		
	5	-2,422.772		
	6	-3,131.298 ***		
	7	-2,984.154		
	8	-1,679.059		
21A	1	-2.089	5.6	0.78
	2	-20.621		
21B	1	-18.731	12.9	0.49
21CD	1	9.139	2.7	< 0.01
	2	1.648		
21E	1	-1.089	3.9	0.52
	2	-4.202		
	3	-4.602		
	4	-6.560 *		
	5	-4.623		
	6	-2.067		
	7	-0.754		
	8	-0.460		
22A	1	-17.621	36.1	0.52
	2	-9.111		
	3	-31.868 *		
23	1	-19.783	17.3	0.12
28	1	35.493 *	7.4	0.93

VEC Analysis - Germany (continued)				
Product Category	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
29	1	-238.652	1.0	0.15
29A	1	78.027	11.2	0.80
31	1	-120.893	5.4	0.31
32	1	-67.269	4.7	0.71
	2	-49.496		
33A	1	-363.641	2.9	0.75
	2	-81.614		
	3	-71.607		
	4	-23.201		
33B	1	-167.621	6.0	0.38
	2	-56.318		
34	1	-33.910 ***	28.3	0.20
	2	-6.102		
	3	-23.870 *		
35	1	-56.572	28.2	0.04
	2	-14.043		
	3	-65.329		
	4	-78.196		
	5	-38.736		
36	1	-61.230 ***	20.7	0.01
	2	-72.957 ***		
	3	-16.680		
	4	-15.522		
	5	-1.848		
37	1	-1.685	2.3	0.45
	2	-57.847		

Source:
Author's calculations (EViews®)

* statistically significant at 68% error bands
** statistically significant at 90% error bands
*** statistically significant at 95% error bands

1. Included and Excluded Steel Product Categories

The steel product category analysis for Germany includes 35 of 36 categories. One category (22b) has been excluded from the analysis because in this category there have been exports to the U.S. in less than ten months during the sample period.

2. Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to decreasing steel exports from Germany to the U.S. in 29 of the 35 product categories analysed (82.9%) and to increasing exports in 6 categories (17.1%).

The average immediate decline for the 35 categories lasts for 2.3 months. The average decline for the 29 categories with decreasing export volumes lasts for 3.1 months while the average increase for the 6 categories with increasing export volumes lasts for 1.3 months.

22 of the 98 single impulse response values are statistically significant (relative share: 22.4%), 16 at 68% error bands and 6 at 95% error bands. 21 of the 90 negative impulse response values (relative share: 23.3%) are statistically significant (68% error bands: 15; 95% error bands: 6), and 1 of the 8 positive impulse response values (relative share: 21.1%) is also statistically significant at 68% error bands. This means that 95.5% of the statistically significant impulse response values are negative.

The impulse response estimates for 13 of 35 categories (relative share: 37.1%) are (at least partially) statistically significant. When discriminating between categories with positive and negative impulse response estimates, 12 of 29 or 41.4% of the categories with negative estimates are statistically significant while 1 of 6 or 16.7% of the categories with positive estimates are statistically significant. This means that 92.3% of the statistically significant impulse response estimates are negative.

3. Variance Decomposition Analysis

The average relative share of volatility in the steel export variable that is due to variation in the oil price variable is 13.8% (moderate) for all categories included, 15.2% (moderate) for the categories with negative impulse responses, and 6.8% (low) for the categories with positive impulse responses.

The average relative variation in the steel export variable that can be explained by variation in the oil price variable is very low for 9 of the 35 categories (25.7%), low for 8 categories (22.9%), moderate for 10 categories (28.6%), high for 5 categories (14.3%), and very high for 3 categories (8.6%).

Comparing the average relative importance of the explanatory variables to the volatility of the steel export variable (oil price: 13.8%; steel import value: 8.8%; exchange rates: 6.6%; U.S. real GDP: 7.2%) shows that the oil price variable has the largest explanatory power of all explanatory variables. To put it differently, the oil price variable explains most of the variation in the steel export variable relative to the other explanatory variables for 14 of 35 or 40% of the categories analysed.

4. Granger Causality Analysis

The GC test results confirm the statistical usefulness or the predictive value of the oil price variable for the steel export variable for 6 of 35 categories (1% level: 3; 5% level: 2; 10% level: 1), a relative share of 17.1%.

5. Price Pattern Analysis

During the sample period, Germany exported significant volumes of steel to the U.S. in 28 of 29 low-value steel product categories (96.6%) and in 7 of 7 high-value categories (100%).

Following a one-standard deviation oil price shock, steel exports to the U.S. decrease in 23 of 28 low-value steel product categories (82.1%) and in 6 of 7 high-value categories (85.7%).

On average, exports in low-value steel product categories decrease for 2.1 months and exports in high-value categories decline for 2.9 months.

The impulse response estimates are statistically significant for 10 of 28 low-value steel product categories (35.7%) and for 3 of 7 high-value categories (42.9%).

The average relative volatility in the steel export variable that can be explained by variation in the oil price variable is 13.2% (moderate) for the low-value categories and 16% (moderate) for the high value categories.

6. Conclusion

Impulse Responses and Variance Decomposition

A one-standard deviation shock in the oil price variable leads to decreasing export volumes from Germany to the U.S. for 82.9% of the categories analysed. On average, steel exports to the U.S. decline for 2.3 months. When it comes to the relative share of positive and negative statistically significant impulse response values, 95.5% of the statistically significant values are negative. Moreover, 92.3% of the statistically significant impulse response estimates are negative.

For the categories analysed, the average relative variation in the steel export variable that can be attributed to volatility in the oil price variable is moderate (28.6%), high (14.3%), or very high (8.6%) for a small majority of the categories analysed (51.5%) which serves as an indicator for the significant explanatory power of the oil price variable for the steel export variable. Thereby, the average share of volatility in the steel export variable that is due to variation in the oil price variable for all categories analysed is 13.8% (moderate).

Summing up, there is evidence that German steel exports to the U.S. are negatively impacted by an oil price shock. The results are in line with the findings for total German steel exports to the U.S. in section 6.2.1.9. Moreover, the variance decomposition estimates provide evidence for the explanatory power oil prices can have for steel trade volumes.

Price Patterns

The following findings provide evidence for the hypothesis that oil price shocks have a stronger impact on low-value steel trade than on high-value steel trade:

- The relative share of steel product categories for which significant volumes of steel have been exported from Germany to the U.S. during the sample period is larger for high-value exports (100%) than for low-value exports (96.6%).

The following findings provide evidence against the hypothesis:

- While export volumes from Germany to the U.S. decline for 85.7% of the high-value categories, export volumes decline for only 82.1% of low-value categories.
- The average decline of steel exports from Germany to the U.S. lasts longer for high-value exports (2.9 months) than for low-value exports (2.1 months).
- The relative share of statistically significant impulse response estimates is higher for high-value categories (42.9%) than for low-value categories (35.7%).
- On average, the explanatory power of the oil price variable for the steel export variable is higher for high-value categories (16%) than for low-value categories (13.2%).

The majority of the estimates contradict the hypothesis that low-value steel trade is impacted more by oil price shocks than high-value steel trade.

6.4.2.4 Italy

Table 6.34 VEC Analysis - Italy

Product Category	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
1A	1	-121.059 ***	21.9	0.61
	2	-78.139 *		
	3	-20.619		
	4	-7.348		
	5	-13.234		
	6	-38.174		
1B	1	1,290.756 *	57.2	0.00
3	1	-391.825	27.6	0.79
	2	-71.004		

VEC Analysis - Italy (continued)				
Product Category	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
4	1	-64.803	15.6	< 0.01
	2	-261.657		
	3	-659.335 *		
	4	-246.941		
	5	-350.342		
	6	-214.713		
6A	1	-197.434 ***	31.7	0.11
6B	1	-34.310	13.7	0.00
7	1	-4.087	1.8	0.00
14	1	-7.544	3.2	0.60
	2	-124.475 *		
	3	-112.829		
	4	-41.308		
	5	-80.199		
	6	-1.909		
14A	1	-10.414	19.1	0.89
	2	-27.886 *		
	3	-27.156 *		
15	1	-281.454	7.9	< 0.01
	2	-440.171 *		
	3	-44.282		
	4	-302.705		
	5	-66.947		
	6	-24.365		
	7	-269.813		
	8	-551.966 *		
	9	-410.961		
	10	-545.252		
	11	-262.405		
16	1	-31.591	9.3	0.45
	2	-3.551		
	3	-2.427		
	4	-39.448		
	5	-58.103 *		
	6	-20.067		
	7	-88.104 ***		
17	1	7.132	20.2	0.00
18	1	-4.727	41.1	0.17
	2	-19.946		
	3	-5.596		
	4	-3.606		

VEC Analysis - Italy (continued)				
Product Category	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
19	1	26.769 **	36.9	0.45
20	1	-411.229	17.3	0.00
	2	-269.627		
	3	-1,410.720 ***		
	4	-680.891		
	5	-944.059 *		
	6	-1,335.018 ***		
	7	-502.652		
	8	-167.915		
	9	-86.534		
	10	-760.773 *		
21A	1	-23.777	24.9	0.03
21B	1	-17.705	3.1	0.35
	2	-8.800		
	3	-34.935 *		
	4	-26.785 *		
	5	-3.546		
21CD	1	-32.000 **	52.8	0.01
21E	1	-0.934	2.3	0.82
	2	-1.135		
	3	-0.687		
	4	-0.938		
	5	-0.651		
	6	-0.545		
22A	1	-4.210	35.9	0.21
	2	-18.001 ***		
	3	-6.972		
	4	-14.006 ***		
	5	-7.350 *		
	6	-7.543 *		
	7	-8.401 *		
23	1	-4.486	3.8	0.32
	2	-31.406		
	3	-19.363		
	4	-2.597		
31	1	-161.986	23.8	0.61

VEC Analysis - Italy (continued)				
Product Category	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
32	1	-283.454	1.1	0.69
	2	-171.645		
	3	-364.702		
	4	-67.609		
33A	1	-43.630	2.1	0.07
	2	-69.312		
	3	-85.369		
34	1	-20.126 *	20.6	0.70
35	1	-7.988	7.4	0.63
	2	-26.821		
36	1	-2.500 *	17.2	0.02
	2	-2.332 *		
	3	-4.693 **		
37	1	4.412	3.3	0.64

Source:
Author's calculations (EViews®)

* statistically significant at 68% error bands
** statistically significant at 90% error bands
*** statistically significant at 95% error bands

1. Included and Excluded Steel Product Categories

The steel product category analysis for Italy includes 28 of 36 categories. Eight categories have been excluded from the analysis for the following reasons:

- no exports to the U.S. during the sample period: 29, 29a
- exports to the U.S. during the sample period in less than ten months: 5, 8, 9, 22b, 28, 33b

2. Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to decreasing steel exports from Italy to the U.S. in 24 of the 28 steel product categories analysed (85.7%) and to increasing exports in 4 categories (14.3%).

The average immediate decline for the 28 categories lasts for 3.3 months. The average decline for the 24 categories with decreasing export volumes lasts for 4 months while the average increase for the 4 categories with increasing export volumes lasts for 1 month.

29 of the 100 single impulse response values are statistically significant (relative share: 29%), 19 at 68% error bands, 3 at 90% error bands, and 7 at 95% error bands. 27 of the 96 negative impulse response values (relative share: 28.1%) are statistically significant (68%

error bands: 18; 90% error bands: 2; 95% error bands: 7) and 2 of the 4 positive impulse response values (relative share: 50%) are also statistically significant (68% error bands: 1; 90% error bands: 1). This means that 93.1% of the statistically significant impulse response values are negative.

The impulse response estimates for 15 of 28 categories (relative share: 53.6%) are (at least partially) statistically significant. When discriminating between categories with positive and negative impulse response estimates, 13 of 24 or 54.2% of the categories with negative estimates are statistically significant while 2 of 4 or 50% of the categories with positive estimates are statistically significant. This means that 86.7% of the statistically significant impulse response estimates are negative.

3. Variance Decomposition Analysis

The average relative share of volatility in the steel export variable that is due to variation in the oil price variable is 18.7% (moderate) for all categories included, 16.9% (moderate) for the categories with negative impulse responses, and 29.4% (high) for the categories with positive impulse responses.

The average relative variation in the steel export variable that can be explained by variation in the oil price variable is very low for 8 of the 28 categories (28.6%), low for 3 categories (10.7%), moderate for 5 categories (17.9%), high for 6 categories (21.4%), and very high for 6 categories (21.4%).

Comparing the average relative importance of the explanatory variables to the volatility of the steel export variable (oil price: 18.7%; steel import value: 13.5%; exchange rates: 7%; U.S. real GDP: 7.2%) shows that the oil price variable has the largest explanatory power of all explanatory variables. To put it differently, the oil price variable explains most of the variation in the steel export variable relative to the other explanatory variables for 14 of 28 or 50% of the categories analysed.

4. Granger Causality Analysis

The GC test results confirm the statistical usefulness or the predictive value of the oil price variable for the steel export variable for 11 of 28 categories (1% level: 7; 5% level: 3; 10% level: 1), a relative share of 39.4%.

5. Price Pattern Analysis

During the sample period, Italy exported significant volumes of steel to the U.S. in 21 of 29 low-value steel product categories (72.4%) and in 7 of 7 high-value categories (100%).

Following a one-standard deviation oil price shock, steel exports to the U.S. decrease in 19 of 21 low-value steel product categories (90.5%) and in 5 of 7 high-value categories (71.4%).

On average, exports in low-value steel product categories decrease for 3.3 months and exports in high-value categories decline for 3.8 months.

The impulse response estimates are statistically significant for 11 of 21 low-value steel product categories (52.4%) and for 4 of 7 high-value categories (57.1%)

The average relative volatility in the steel export variable that can be explained by variation in the oil price variable is 19.5% (moderate) for the low-value categories and 16.1% (moderate) for the high-value categories.

6. Conclusion

Impulse Responses and Variance Decomposition

A one-standard deviation shock in the oil price variable leads to decreasing export volumes from Italy to the U.S. for 85.7% of the categories analysed. On average, steel exports to the U.S. decline for 3.3 months. When it comes to the relative share of positive and negative statistically significant impulse response values, 93.1% of the statistically significant values are negative. Moreover, 86.7% of the statistically significant impulse response estimates are also negative.

For the categories analysed, the average relative variation in the steel export variable that can be attributed to volatility in the oil price variable is moderate (17.9%), high (21.4%), or very high (21.4%) for a significant majority of the categories analysed (60.7%). This is an indicator for the significant explanatory power of the oil price variable for the steel export variable. Thereby, the average share of volatility in the steel export variable that is due to variation in the oil price variable for all categories analysed is 18.7% (moderate).

Recapitulatory, there is evidence that Italian steel exports to the U.S. are negatively impacted by an oil price shock. The results are in line with the findings for total Italian steel exports to the U.S. in section 6.2.1.12. Moreover, the variance decomposition estimates provide evidence for the explanatory power oil prices can have for steel trade volumes.

Price Patterns

The following findings provide evidence for the hypothesis that oil price shocks have a stronger impact on low-value steel trade than on high-value steel trade:

- The relative share of steel product categories for which significant volumes of steel have been exported from Italy to the U.S. during the sample period is larger for high-value exports (100%) than for low-value exports (72.4%).

- While export volumes from Italy to the U.S. decline for 90.5% of the low-value categories, export volumes decline for only 71.4% of high-value categories.
- On average, the explanatory power of the oil price variable for the steel export variable is higher for low-value categories (19.5%) than for high-value categories (16.1%).

The following findings provide evidence against the hypothesis:

- The average decline of steel exports from Italy to the U.S. lasts longer for high-value exports (3.8 months) than for low-value exports (3.3 months).
- The relative share of statistically significant impulse response estimates is higher for high-value categories (57.1%) than for low-value categories (52.4%).

The estimates provide mixed evidence. Therefore, no definite statement can be made regarding possible price patterns. By tendency, the evidence found that supports the hypothesis of price patterns is somewhat stronger than the evidence contradicting the hypothesis.

6.4.2.5 Netherlands

Table 6.35 VEC Analysis - Netherlands

Product Category	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
1B	1	-409.434 *	31.1	0.65
3	1	-11.330	7.3	0.67
4	1	5.050	19.0	0.49
	2	4.630		
6A	1	-0.529	22.8	0.09
6B	1	-247.250	53.2	0.00
	2	-472.807 *		
14	1	-18.722	15.8	0.06
14A	1	-2.061	25.2	0.00
16	1	-4.075 ***	13.7	0.19
17	1	-6.245	20.5	0.02
	2	-16.408		
	3	-12.609		
	4	-3.801		
	5	-25.622 *		

VEC Analysis - Netherlands (continued)				
Product Category	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
18	1	-41.545 *	14.8	0.01
19	1	1.590	26.7	0.11
20	1	21.513	0.3	0.24
21A	1	-1.495	5.8	0.02
21B	1	-18.975 *	27.0	0.02
21CD	1	-0.159	3.7	0.77
	2	-1.273		
21E	1	-0.011	12.1	0.25
	2	-0.071		
22A	1	-0.460	16.3	0.43
	2	-0.804 *		
	3	-0.315		
	4	-1.383 ***		
	5	-0.645 *		
23	1	-0.534	7.7	0.30
	2	-7.827 *		
	3	-10.880 **		
	4	-6.497 *		
	5	-3.760		
28	1	-15.926	6.8	0.69
29	1	-538.103 ***	16.2	0.00
	2	-1,034.693 ***		
	3	-644.400 ***		
29A	1	94.487	4.7	0.67
	2	79.437		
	3	30.878		
31	1	-602.005	3.9	0.36
32	1	-188.091	11.1	0.49
	2	-8.200		
33A	1	-38.599	39.4	0.29
34	1	3.106	4.3	0.53
	2	23.149 **		
	3	9.105		
	4	10.199		
	5	0.468		
	6	2.710		
37	1	-1.347	17.8	0.39
	2	-0.944		

Source:
Author's calculations (EViews®)

* statistically significant at 68% error bands
** statistically significant at 90% error bands
*** statistically significant at 95% error bands

1. Included and Excluded Steel Product Categories

The steel product category analysis for the Netherlands includes 26 of 36 categories. 10 categories (1a, 5, 7, 8, 9, 15, 22b, 33b, 35, 36) have been excluded from the analysis because steel products from these categories were exported to the U.S. in less than ten months during the sample period.

2. Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to decreasing steel exports from the Netherlands to the U.S. in 21 of the 26 steel product categories analysed (80.8%) and to increasing exports in 5 categories (19.2%).

The average immediate decline for the 26 categories lasts for 1 month. The average decline for the 21 categories with decreasing export volumes lasts for 1.9 months while the average increase for the 5 categories with increasing export volumes lasts for 2.6 months.

16 of the 53 single impulse response values are statistically significant (relative share: 30.2%), 9 at 68% error bands, 2 at 90% error bands, and 5 at 95% error bands. 15 of the 40 negative impulse response values (relative share: 37.5%) are statistically significant (68% error bands: 9; 90% error bands: 1; 95% error bands: 5) and 1 of the 13 positive impulse response values (relative share: 7.7%) is statistically significant at 90% error bands. This means that 93.8% of the statistically significant impulse response values are negative.

The impulse response estimates for 10 of 26 categories (relative share: 38.5%) are (at least partially) statistically significant. When discriminating between categories with positive and negative impulse response estimates, 9 of 21 or 42.9% of the categories with negative estimates are statistically significant while 1 of 5 or 20% of the categories with positive estimates are statistically significant. This means that 90% of the statistically significant impulse response estimates are negative.

3. Variance Decomposition Analysis

The average relative share of volatility in the steel export variable that is due to variation in the oil price variable is 16.4% (moderate) for all categories included, 17.7% (moderate) for the categories with negative impulse responses, and 11% (moderate) for the categories with positive impulse responses.

The average relative variation in the steel export variable that can be explained by variation in the oil price variable is very low for 5 of the 26 categories (19.2%), low for 4 categories (15.4%), moderate for 9 categories (34.6%), high for 5 categories (19.2%), and very high for 3 categories (11.5%).

Comparing the average relative importance of the explanatory variables to the volatility of the steel export variable (oil price: 16.4%; steel import value: 10.9%; exchange rates: 5.9%;

U.S. real GDP: 5.8%) shows that the oil price variable has the largest explanatory power of all explanatory variables. To put it differently, the oil price variable explains most of the variation in the steel export variable relative to the other explanatory variables for 13 of 26 or 50% of the categories analysed.

4. Granger Causality Analysis

The GC test results confirm the statistical usefulness or the predictive value of the oil price variable for the steel export variable for 9 of 26 categories (1% level: 3; 5% level: 4; 10% level: 2), a relative share of 34.6%.

5. Price Pattern Analysis

During the sample period, the Netherlands exported significant volumes of steel to the U.S. in 20 of 29 low-value steel product categories (69%) and in 6 of 7 high-value categories (85.7%).

Following a one-standard deviation oil price shock, steel exports to the U.S. decrease in 15 of 20 low-value steel product categories (75%) and in 6 of 6 high-value categories (100%).

On average, exports in low-value steel product categories decrease for 0.7 months and exports in high-value categories decline for 2.2 months.

The impulse response estimates are statistically significant for 7 of 20 low-value steel product categories (35%) and for 3 of 6 high-value categories (50%)

The average relative volatility in the steel export variable that can be explained by variation in the oil price variable is 16.6% (moderate) for the low-value categories and 15.8% (moderate) for the high value categories.

6. Conclusion

Impulse Responses and Variance Decomposition

A one-standard deviation shock in the oil price variable leads to decreasing export volumes from the Netherlands to the U.S. for 80.8% of the categories analysed. On average, steel exports to the U.S. decline for 1 month. When it comes to the relative share of positive and negative statistically significant impulse response values, 93.8% of the statistically significant values are negative. Moreover, 90% of the statistically significant impulse response estimates are also negative.

For the categories analysed, the average relative variation in the steel export variable that can be attributed to volatility in the oil price variable is moderate (34.6%), high (19.2%), or very high (11.5%) for two thirds of the categories analysed (65.3%). This is an indicator for the significant explanatory power of the oil price variable for the steel export variable. The average share of volatility in the steel export variable that is due to variation in the oil price variable for all categories analysed is 16.4% (moderate).

Summing up, there is evidence that Dutch steel exports to the U.S. are negatively impacted by an oil price shock. The results are in line with the findings for total Dutch steel exports to the U.S. in section 6.2.1.16. Moreover, the variance decomposition estimates provide evidence for the explanatory power oil prices can have for steel trade volumes.

Price Patterns

The following findings provide evidence for the hypothesis that oil price shocks have a stronger impact on low-value steel trade than on high-value steel trade:

- The relative share of steel product categories for which significant volumes of steel have been exported from the Netherlands to the U.S. during the sample period is larger for high-value exports (85.7%) than for low-value exports (69%).
- On average, the explanatory power of the oil price variable for the steel export variable is higher for low-value categories (16.6%) than for high-value categories (15.8%).

The following findings contradict the hypothesis:

- While export volumes from the Netherlands to the U.S. decline for 100% of the high-value categories, export volumes decline for only 75% of low-value categories.
- The average decline of steel exports from the Netherlands to the U.S. lasts longer for high-value exports (2.2 months) than for low-value exports (0.7 months).
- The relative share of statistically significant impulse response estimates is higher for high-value categories (50%) than for low-value categories (35%).

The averages of the estimates provide mixed evidence so that no definite statement can be made with regard to possible price patterns. By tendency, the evidence found that contradicts the hypothesis of price patterns is somewhat stronger than the evidence supporting the hypothesis.

6.4.2.6 Spain

Table 6.36 VEC Analysis - Spain

Product Category	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
1B	1	-193.741	3.2	0.28
3	1	364.641	2.2	0.60
4	1	-1,748.329 ***	6.9	0.03
	2	-1,009.866		
	3	-193.854		
	4	-484.956		
	5	-273.975		
6A	1	9.973 *	9.0	0.04
	2	7.053		
6B	1	-30.768	8.3	0.48
	2	-65.104 *		
	3	-21.901		
7	1	-52.442 *	2.5	0.56
8	1	12.863	1.6	0.40
14	1	-302.794 *	14.0	0.62
	2	-4.189		
14A	1	2.136	9.3	< 0.01
	2	3.775		
16	1	-62.087 *	27.8	0.00
	2	-41.809		
17	1	-16.673 *	24.6	0.78
	2	-1.173		
	3	-26.215 **		
	4	-1.030		
	5	-9.699		
	6	-12.089		
18	1	84.354	12.2	0.84
	2	19.699		
19	1	-24.923	16.4	0.60
	2	-135.048		
20	1	9.944	40.3	0.00
	2	3.656		
21A	1	-0.570	6.4	0.88
	2	-75.997		
	3	-47.030		
21B	1	-12.440 *	35.6	0.13
	2	-9.240		

VEC Analysis - Spain (continued)				
Product Category	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
21CD	1	-6.983	17.0	0.64
21E	1	-0.193	9.7	0.00
22A	1	-1.885 *	11.9	0.30
	2	-1.188		
	3	-2.437 *		
	4	-1.599		
	5	-2.221 *		
	6	-0.044		
23	1	-3.737	14.0	0.40
	2	-10.939		
	3	-29.006 **		
	4	-9.488		
	5	-23.033 *		
	6	-2.767		
29	1	-24.612	14.6	0.04
	2	-8.995		
	3	-81.847 *		
	4	-120.127 ***		
31	1	-35.067	4.3	0.31
	2	-177.656 *		
	3	-452.147 ***		
	4	-76.900		
	5	-17.607		
32	1	-9.584	14.9	0.02
33A	1	-240.307 ***	40.6	0.03
	2	-363.882 ***		
	3	-261.484 ***		
	4	-234.264 **		
	5	-180.579 *		
	6	-127.067		
	7	-132.921		
33B	1	-7.533	6.6	0.61
	2	-28.238		
34	1	-0.416	12.7	0.00
	2	-0.671		
37	1	-2.134	12.7	0.87

Source:
Author's calculations (EViews®)

* statistically significant at 68% error bands
** statistically significant at 90% error bands
*** statistically significant at 95% error bands

1. Included and Excluded Steel Product Categories

The steel product category analysis for Spain includes 27 of 36 categories. Nine categories have been excluded from the analysis for the following reasons:

- no exports to the U.S. during the sample period: 1a, 5, 9, 15, 22b, 28, 29a, 35
- category sample includes one or more I(2) variables: 36

2. Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to decreasing steel exports from Spain to the U.S. in 21 of the 27 steel product categories analysed (77.8%) and to increasing exports in 6 categories (22.2%).

The average immediate decline for the 27 categories lasts for 2 months. The average decline for the 21 categories with decreasing export volumes lasts for 3 months while the average increase for the 6 categories with increasing export volumes lasts for 1.7 months.

23 of the 73 single impulse response values are statistically significant (relative share: 31.5%), 11 at 68% error bands, 3 at 90% error bands, and 6 at 95% error bands. 22 of the 40 negative impulse response values (relative share: 34.9%) are statistically significant (68% error bands: 13; 90% error bands: 3; 95% error bands: 6) and 1 of the 10 positive impulse response values (relative share: 10%) is also statistically significant at 90% error bands. This means that 95.6% of the statistically significant impulse response values are negative.

The impulse response estimates for 13 of 27 categories (relative share: 48.1%) are (at least partially) statistically significant. When discriminating between categories with positive and negative impulse response estimates, 12 of 21 or 57.1% of the categories with negative estimates are statistically significant while 1 of 6 or 16.7% of the categories with positive estimates are statistically significant. This means that 92.3% of the statistically significant impulse response estimates are negative.

3. Variance Decomposition Analysis

The average relative share of volatility in the steel export variable that is due to variation in the oil price variable is 14.1% (moderate) for all categories included, 14.5% (moderate) for the categories with negative impulse responses, and 12.4% (moderate) for the categories with positive impulse responses.

The explanatory power of the oil price variable for the steel export variable is very low for 5 of the 26 categories (18.5%), low for 7 categories (25.9%), moderate for 10 categories (37%), high for 2 categories (7.4%), and very high for 3 categories (11.1%).

Comparing the average relative importance of the explanatory variables to the volatility of the steel export variable (oil price: 14.1%; steel import value: 12.7%; exchange rates: 5.8%; U.S. real GDP: 6.4%) shows that the oil price variable has the largest explanatory power of all explanatory variables. To put it differently, the oil price variable explains most of the variation in the steel export variable relative to the other explanatory variables for 11 of 27 or 40.7% of the categories analysed.

4. Granger Causality Analysis

The GC test results confirm the statistical usefulness or the predictive value of the oil price variable for the steel export variable for 10 of 27 categories (1% level: 5; 5% level: 5), a relative share of 37%.

5. Price Pattern Analysis

During the sample period, Spain exported significant volumes of steel to the U.S. in 21 of 29 low-value steel product categories (72.4%) and in 6 of 7 high-value categories (85.7%).
Following a one-standard deviation oil price shock, steel exports to the U.S. decrease in 15 of 21 low-value steel product categories (71.4%) and in 6 of 6 high-value categories (100%).
On average, exports in low-value steel product categories decrease for 1.9 months and exports in high-value categories decline for 2.2 months.
The impulse response estimates are statistically significant for 9 of 21 low-value steel product categories (42.9%) and for 3 of 6 high-value categories (50%)
The average relative volatility in the steel export variable that can be explained by variation in the oil price variable is 12% (moderate) for the low-value categories and 21.2% (high) for the high-value categories.

6. Conclusion

Impulse Responses and Variance Decomposition

A one-standard deviation shock in the oil price variable leads to decreasing export volumes from Spain to the U.S. for 77.8% of the categories analysed. On average, steel exports to the U.S. decline for 2 months. When it comes to the relative share of positive and negative statistically significant impulse response values, 95.6% of the statistically significant values are negative. Moreover, 92.3% of the statistically significant impulse response estimates are also negative.
For the categories analysed, the average relative variation in the steel export variable that can be attributed to volatility in the oil price variable is moderate (37%), high (7.4%), or very high (11.1%) for the majority of the categories analysed (55.5%) which is an indicator for the significant explanatory power of the oil price variable for the steel export variable. Thereby, the average share of volatility in the steel export variable that is due to variation in the oil price variable for all categories analysed is 14.1% (moderate).

Summing up, there is evidence that Spanish steel exports to the U.S. are negatively impacted by an oil price shock. The results are in line with the findings for total Spanish steel exports to the U.S. in section 6.2.1.21. Moreover, the variance decomposition estimates provide evidence for the explanatory power oil prices can have for steel trade volumes.

Price Patterns

The following findings provide evidence for the hypothesis that oil price shocks have a stronger impact on low-value steel trade than on high-value steel trade:

- The relative share of steel product categories for which significant volumes of steel have been exported from Spain to the U.S. during the sample period is larger for high-value exports (85.7%) than for low-value exports (72.4%).

The following findings provide evidence against the hypothesis:

- While export volumes from Spain to the U.S. decline for 100% of the high-value categories, export volumes decline for only 71.4% of the low-value categories.
- The average decline of steel exports from Spain to the U.S. lasts longer for high-value exports (2.2 months) than for low-value exports (1.9 months).
- The relative share of statistically significant impulse response estimates is higher for high-value categories (50%) than for low-value categories (42.9%).
- On average, the explanatory power of the oil price variable for the steel export variable is higher for high-value categories (21.2%) than for low-value categories (12%).

The majority of the estimates contradict the hypothesis that low-value steel trade is impacted more by oil price shocks than high-value steel trade.

6.4.3 C.I.S.

For the C.I.S., Russia (6.4.3.1) and the Ukraine (6.4.3.2) have been selected for the analysis of steel exports to the U.S. per steel product category.

6.4.3.1 Russia

Table 6.37 VEC Analysis - Russia

Product Category	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
1B	1	-3,886.820	6.8	0.66
	2	-6,317.588		
	3	-8,687.294 *		
	4	-5,875.417		
	5	-3,967.387		
	6	-659.105		
3	1	-145.463 *	36.1	0.00
	2	-91.741		
	3	-340.016 ***		
	4	-75.127		
4	1	-14.555	7.7	0.27
	2	-94.093		
	3	-567.544 *		
6A	1	-253.940	4.5	0.74
	2	-290.684		
6B	1	770.150	21.0	< 0.01
14	1	-227.669	12.1	0.19
	2	-89.674		
	3	-104.261		
	4	-147.712		
	5	-248.456		
	6	-266.737 *		
	7	-176.061		
	8	-161.909		
15	1	-28.717	4.2	0.32
	2	-30.200		
16	1	-357.355 **	19.0	0.00
17	1	-35.370	22.9	0.00
	2	-82.539 ***		
	3	-70.005 **		
	4	-9.905		
	5	-4.302		
18	1	-34.830	19.1	0.62

VEC Analysis - Russia (continued)				
Product Category	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
19	1	-170.431	26.9	0.04
	2	-46.064		
	3	-387.822 **		
	4	-253.906 *		
	5	-564.533 ***		
	6	-499.609 **		
	7	-167.003		
20	1	-57.088	3.9	0.39
21A	1	-98.704 **	33.8	0.00
	2	-16.380		
	3	-217.732 ***		
	4	-85.208 *		
	5	-101.671 *		
	6	-269.485 ***		
	7	-126.028 **		
	8	-0.935		
23	1	-12.521	5.8	0.47
31	1	1,253.302	6.4	0.45
32	1	-1,060.719	3.4	0.63
	2	-1,596.476		
	3	-27.192		
33A	1	-28.185	11.4	0.00
35	1	-77.394	7.0	0.21
	2	-127.490 *		
	3	-307.037 ***		
	4	-35.784		
	5	-13.847		
	6	-91.122		
	7	-27.801		
37	1	-11.856 *	2.1	0.00

Source:
Author's calculations (EViews®)

* statistically significant at 68% error bands
** statistically significant at 90% error bands
*** statistically significant at 95% error bands

1. Included and Excluded Steel Product Categories

The steel product category analysis for Russia includes 19 of 36 categories. 15 categories have been excluded from the analysis for the following reasons:

- no exports to the U.S. during the sample period: 5, 8, 9, 22b, 29, 34
- exports to the U.S. during the sample period in less than ten months: 1a, 7, 14a, 21b, 21cd, 21e, 22a, 28, 29a, 33b, 36

2. Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to decreasing steel exports from Russia to the U.S. in 17 of the 19 steel product categories analysed (89.5%) and to increasing exports in the remaining 2 categories (10.5%).

The average immediate decline for the 19 categories lasts for 3.1 months. The average decline for the 17 categories with decreasing export volumes lasts for 3.6 months while the average increase for the 2 categories with increasing export volumes lasts for 1 month.

21 of the 63 single impulse response values are statistically significant (relative share: 33.3%), 9 at 68% error bands, 6 at 90% error bands, and 6 at 95% error bands. 21 of the 61 negative impulse response values (relative share: 34.4%) are statistically significant (68% error bands: 9; 90% error bands: 6; 95% error bands: 6), and none of the 2 positive impulse response values is statistically significant. This means that 100% of the statistically significant impulse response values are negative.

The impulse response estimates for 10 of 19 categories (relative share: 52.6%) are (at least partially) statistically significant. When discriminating between categories with positive and negative impulse response estimates, 10 of 17 or 58.8% of the categories with negative estimates are statistically significant while none of the 2 categories with positive estimates is statistically significant. This means that 100% of the statistically significant impulse response estimates are negative.

3. Variance Decomposition Analysis

The average relative share of volatility in the steel export variable that is due to variation in the oil price variable is 13.4% (moderate) for all categories included, 13.3% (moderate) for the categories with negative impulse responses, and 13.7% (moderate) for the categories with positive impulse responses.

The average relative variation in the steel export variable that can be explained by variation in the oil price variable is very low for 5 of the 19 categories (26.3%), low for 5 categories (26.3%), moderate for 4 categories (21.1%), high for 3 categories (15.8%), and very high for 2 categories (10.5%).

Comparing the average relative importance of the explanatory variables to the volatility of the steel export variable (oil price: 13.4%; steel import value: 16.7%; exchange rates: 10.5%; U.S. real GDP: 6%) shows that the oil price variable has the second-largest explanatory power of all explanatory variables. To put it differently, the oil price variable explains most of the variation in the steel export variable relative to the other explanatory variables for 6 of 19 or 31.6% of the categories analysed.

4. Granger Causality Analysis

The GC test results confirm the statistical usefulness or the predictive value of the oil price variable for the steel export variable for 8 of 19 categories (1% level: 7; 5% level: 1), a relative share of 42.1%.

5. Price Pattern Analysis

During the sample period, Russia exported significant volumes of steel to the U.S. in 16 of 29 low-value steel product categories (55.1%) and in 3 of 7 high-value categories (42.9%).
Following a one-standard deviation oil price shock, steel exports to the U.S. decrease in 14 of 16 low-value steel product categories (87.5%) and in 3 of 3 high value categories (100%).
On average, exports in low-value steel product categories decrease for 3.3 months and exports in high-value categories decline for 2.3 months.
The impulse response estimates are statistically significant for 7 of 16 low-value steel product categories (43.8%) and for 3 of 3 high-value categories (100%).
The average relative volatility in the steel export variable that can be explained by variation in the oil price variable is 13.1% (moderate) for the low-value categories and 14.7% (moderate) for the high-value categories.

6. Conclusion

Impulse Responses and Variance Decomposition

A one-standard deviation shock in the oil price variable leads to decreasing export volumes from Russia to the U.S. for 89.5% of the categories analysed. On average, steel exports to the U.S. decline for 3.1 months. When it comes to the relative share of positive and negative statistically significant impulse response values, 100% of the statistically significant values are negative. Therefore, 100% of the statistically significant impulse response estimates are also negative.
For the categories analysed, the average relative variation in the steel export variable that can be attributed to volatility in the oil price variable is moderate (21.1%), high (15.8%), or very high (10.5%) for a strong minority of the categories analysed (47.4%) which serves as an indicator for the significant explanatory power of the oil price variable for the steel export

variable. Thereby, the average share of volatility in the steel export variable that is due to variation in the oil price variable for all categories analysed is 13.4% (moderate).

Recapitulatory, there is evidence that Russian steel exports to the U.S. are negatively impacted by an oil price shock to a significant extent. The results are in line with the findings for total Russian steel exports to the U.S. in section 6.2.3.2. Moreover, the variance decomposition estimates provide evidence for the explanatory power oil prices can have for steel trade volumes.

Price Patterns

The following findings provide evidence for the hypothesis that oil price shocks have a stronger impact on low-value steel trade than on high-value steel trade:

- The average decline of steel exports from Russia to the U.S. lasts longer for low-value exports (3.3 months) than for high-value exports (2.3 months).

The following findings provide evidence against the hypothesis:

- The relative share of steel product categories for which significant volumes of steel have been exported from Russia to the U.S. during the sample period is larger for low-value exports (55.1%) than for high-value exports (42.9%).
- While export volumes from Russia to the U.S. decline for 100% of the high-value categories, export volumes decline for only 87.5% of the low-value categories.
- The relative share of statistically significant impulse response estimates is higher for high-value categories (100%) than for low-value categories (43.8%).
- On average, the explanatory power of the oil price variable for the steel export variable is higher for high-value categories (14.7%) than for low-value categories (13.1%).

The majority of the estimates contradict the hypothesis that low-value steel trade is impacted more by oil price shocks than high-value steel trade.

6.4.3.2 Ukraine

Table 6.38 VEC Analysis - Ukraine

Product Category	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
1B	1	225.757	13.3	0.05
3	1	-2.947	10.1	0.00
	2	-74.833		
4	1	1.064	10.3	< 0.01
	2	0.525		
	3	0.183		
6A	1	-1,319.266 *	23.6	0.09
	2	-1,443.991 *		
6B	1	-20.798	0.3	0.74
	2	-27.492		
14	1	-245.621 **	13.6	0.86
16	1	-269.796 *	11.1	0.00
17	1	-3.684	7.0	0.49
18	1	-111.414 **	1.1	0.44
	2	-30.828		
21A	1	3.506	5.4	0.68
21B	1	-18.770	10.8	0.90
	2	-11.467		
21CD	1	-1.168	19.5	0.00
22A	1	-15.225	2.2	0.49
	2	-20.456		
31	1	-150.715	0.6	0.29
32	1	-6.854	33.4	0.02

Source:
Author's calculations (EViews®)

* statistically significant at 68% error bands
** statistically significant at 90% error bands
*** statistically significant at 95% error bands

<u>1. Included and Excluded Steel Product Categories</u>

The steel product category analysis for Ukraine includes 15 of 36 categories. 21 categories have been excluded from the analysis for the following reasons:

- no exports to the U.S. during the sample period: 5, 7, 9, 22b, 28, 29, 29a, 33b, 34, 35
- exports to the U.S. during the sample period in less than ten months: 1a, 8, 14a, 15, 19, 20, 21e, 23, 33a, 36, 37

2. Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to decreasing steel exports from the Ukraine to the U.S. in 12 of the 15 steel product categories analysed (80%) and to increasing exports in the remaining 3 categories (20%).

The average immediate decline for the 15 categories lasts for 0.9 months. The average decline for the 12 categories with decreasing export volumes lasts for 1.5 months while the average increase for the 3 categories with increasing export volumes lasts for 1.7 months.

Five of the 23 single impulse response values are statistically significant (relative share: 21.7%), 3 at 68% error bands and 2 at 90% error bands. Five of the 18 negative impulse response values (relative share: 27.8%) are statistically significant (68% error bands: 3; 90% error bands: 2), and none of the 5 positive impulse response values is statistically significant. This means that 100% of the statistically significant impulse response values are negative.

The impulse response estimates for 4 of 15 categories (relative share: 26.7%) are (at least partially) statistically significant. When discriminating between categories with positive and negative impulse response estimates, 4 of 12 or 33.3% of the categories with negative estimates are statistically significant while none of the 3 categories with positive estimates is statistically significant. This means that 100% of the statistically significant impulse response estimates are negative.

3. Variance Decomposition Analysis

The average relative share of volatility in the steel export variable that is due to variation in the oil price variable is 10.8% (moderate) for all categories included, 11.1% (moderate) for the categories with negative impulse responses, and 9.7% (low) for the categories with positive impulse responses.

The average relative variation in the steel export variable that can be explained by variation in the oil price variable is very low for 4 of the 15 categories (26.7%), low for 2 categories (13.3%), moderate for 7 categories (46.7%), high for 1 category (6.7%), and very high for 1 category (6.7%).

Comparing the average relative importance of the explanatory variables to the volatility of the steel export variable (oil price: 10.8%; steel import value: 12.1%; exchange rates: 7.7%; U.S. real GDP: 7.7%) shows that the oil price variable has the second-largest explanatory power of all explanatory variables. To put it differently, the oil price variable explains most of the variation in the steel export variable relative to the other explanatory variables for 3 of 15 or 20% of the categories analysed.

4. Granger Causality Analysis

The GC test results confirm the statistical usefulness or the predictive value of the oil price variable for the steel export variable for 7 of 15 categories (1% level: 4; 5% level: 1; 10% level: 2), a relative share of 46.7%.

5. Price Pattern Analysis

During the sample period, Ukraine exported significant volumes of steel to the U.S. in 11 of 29 low-value steel product categories (37.9%) and in 4 of 7 high-value categories (57.1%).
Following a one-standard deviation oil price shock, steel exports to the U.S. decrease in 8 of 11 low-value steel product categories (72.7%) and in 4 of 4 high value categories (100%).
On average, exports in low-value steel product categories decrease for 0.7 months and exports in high-value categories decline for 1.3 months.
The impulse response estimates are statistically significant for 3 of 11 low-value steel product categories (27.3%) and for 1 of 4 high-value categories (25%)
The average relative volatility in the steel export variable that can be explained by variation in the oil price variable is 10.4% (moderate) for the low-value categories and 12.1% (moderate) for the high-value categories.

6. Conclusion

Impulse Responses and Variance Decomposition

A one-standard deviation shock in the oil price variable leads to decreasing export volumes from Ukraine to the U.S. for 80% of the categories analysed. On average, steel exports to the U.S. decline for 0.9 months. When it comes to the relative share of positive and negative statistically significant impulse response values, 100% of the statistically significant values are negative. Moreover, 100% of the statistically significant impulse response estimates are also negative.
For the categories analysed, the average relative variation in the steel export variable that can be attributed to volatility in the oil price variable is moderate (40%), high (6.7%), or very high (6.7%) for the majority of the categories analysed (53.4%) which serves as an indicator for the significant explanatory power of the oil price variable for the steel export variable. Thereby, the average share of volatility in the steel export variable that is due to variation in the oil price variable for all categories analysed is 10.8% (moderate).
Summing up, there is evidence that Ukrainian steel exports to the U.S. are negatively impacted by an oil price shock to a significant extent. The results are in line with the findings for total Ukrainian steel exports to the U.S. in section 6.2.3.3. Moreover, the variance decomposition estimates provide evidence for the explanatory power oil prices can have for steel trade volumes, although the average explanatory power the oil price variable has for the

steel export variable is somewhat lower than for most of the other countries included in the analysis.

Price Patterns

The following findings provide evidence for the hypothesis that oil price shocks have a stronger impact on low-value steel trade than on high-value steel trade:

- The relative share of steel product categories for which significant volumes of steel have been exported from Ukraine to the U.S. during the sample period is larger for high-value exports (57.1%) than for low-value exports (37.9%).
- The relative share of statistically significant impulse response estimates is higher for low-value categories (27.2%) than for high-value categories (25%).

The following findings provide evidence against the hypothesis:

- While export volumes from the Ukraine to the U.S. decline for 100% of the high-value categories, export volumes decline for only 72.7% of the low-value categories.
- The average decline of steel exports from the Ukraine to the U.S. lasts longer for high-value exports (1.3 months) than for low-value exports (0.7 months).
- On average, the explanatory power of the oil price variable for the steel export variable is higher for high-value categories (12.1%) than for low-value categories (10.4%).

The estimates obtained provide mixed evidence. Therefore, no definite statement can be made with regard to possible price patterns. By tendency, the evidence found that contradicts the hypothesis of price patterns is somewhat stronger than the evidence supporting the hypothesis.

It needs to be mentioned that some Ukrainian estimates may be biased by autocorrelation. These estimates need to be interpreted very conservatively.

6.4.4 North America

For North America, Canada (6.4.4.1) and Mexico (6.4.4.2) have been selected for the analysis of steel exports to the U.S. by steel product category.

6.4.4.1 Canada

Table 6.39 VEC Analysis - Canada

Product Category	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
1A	1	59.491 *	12.6	< 0.05
	2	24.751		
1B	1	2,397.878 *	23.0	0.00
	2	304.996		
	3	3,757.515 **		
	4	3,569.199 *		
	5	1,629.989 *		
	6	4,373.584 **		
	7	3,696.790 *		
	8	4,246.018 *		
	9	7,156.999 ***		
	10	1,164.984		
	11	22.803		
	12	1,726.722		
3	1	334.194	15.1	0.88
	2	334.273		
	3	33.378		
	4	364.510		
	5	919.145 ***		
	6	839.341 *		
	7	1,447.325 ***		
	8	1,060.781 *		
	9	1,351.424 **		
	10	1,023.121 *		
	11	663.861		
	12	347.164		
	13	135.960		
4	1	227.315	0.6	0.66
	2	83.682		
5	1	27.599	2.5	0.26
	2	47.469		
	3	42.004		

VEC Analysis - Canada (continued)				
Product Category	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
6A	1	856.212 ***	18.7	0.03
	2	687.717 **		
	3	496.424 *		
	4	580.186 *		
	5	172.211		
6B	1	913.477 *	8.8	0.80
	2	589.643		
	3	338.839		
	4	11.804		
7	1	24.224	1.4	0.68
	2	11.493		
8	1	-2.830	49.0	0.04
9	1	5.236	27.6	0.50
	2	27.387		
	3	61.677 *		
	4	3.128		
14	1	668.122 *	33.8	0.31
14A	1	274.919 *	20.7	0.00
	2	52.806		
15	1	42.841	10.8	0.28
16	1	50.497	18.1	0.02
	2	15.350		
17	1	8.701	3.3	0.24
	2	10.566		
	3	13.811		
	4	12.482		
	5	5.898		
18	1	109.288	25.4	0.09
	2	791.224 **		
	3	1,015.859 ***		
	4	879.163 *		
	5	734.125 *		
	6	443.472		
19	1	663.846 ***	65.9	0.04
	2	541.566 ***		
	3	491.446 ***		
	4	375.384 *		
	5	445.551 **		
20	1	1,121.197 *	20.5	0.07

VEC Analysis - Canada (continued)				
Product Category	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
21A	1	114.619	1.6	0.49
	2	56.259		
	3	55.035		
21B	1	17.856	12.5	0.00
	2	5.192		
21CD	1	-13.077	9.5	0.15
21E	1	11.139	28.2	0.43
	2	29.105 *		
	3	64.899 ***		
	4	20.543		
	5	37.777 *		
	6	34.693 *		
	7	2.634		
	8	30.794 *		
	9	11.698		
22A	1	69.346	23.9	0.00
	2	610.990 ***		
	3	487.339 **		
	4	42.976		
22B	1	115.764	11.6	0.29
	2	122.379		
	3	182.894 *		
	4	35.814		
	5	205.345 *		
	6	189.669 *		
	7	174.896 *		
	8	65.686		
28	1	11.455	0.6	0.66
	2	4.398		
29	1	-631.039 ***	16.8	0.00
29A	1	172.910 **	2.5	0.61
	2	47.336		
31	1	1,315.296 *	4.6	0.05
	2	914.014		
	3	367.181		
	4	76.723		
32	1	167.159	38.3	< 0.01
	2	826.065 ***		
	3	299.906		
	4	294.444		
	5	528.800 *		

VEC Analysis - Canada (continued)				
Product Category	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
33A	1	168.469	32.0	0.18
	2	470.928 *		
	3	661.285 *		
	4	823.565 *		
	5	1,000.791 *		
33B	1	-32.080	2.0	0.24
	2	-11.805		
34	1	21.735	5.9	0.81
35	1	1.036	6.2	0.21
36	1	15.264	3.8	0.58
37	1	2.589	1.7	0.09
	2	33.099		

Source:
Author's calculations (EViews®)

* statistically significant at 68% error bands
** statistically significant at 90% error bands
*** statistically significant at 95% error bands

1. Included and Excluded Steel Product Categories

The steel product category analysis for Canada includes 35 of 36 categories. One category (23) has been excluded from the analysis because it contains two I(2) variables.

2. Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to increasing steel exports from Canada to the U.S. in 31 of the 35 steel product categories analysed (88.6%) and to decreasing exports in the remaining 4 categories (11.4%).

The average immediate increase for the 35 categories lasts for 3.3 months. The average increase for the 31 categories with increasing export volumes lasts for 3.8 months while the average decrease for the 4 categories with decreasing export volumes lasts for 1.3 months.

53 of the 124 single impulse response values are statistically significant (relative share: 42.7%), 33 at 68% error bands, 8 at 90% error bands, and 12 at 95% error bands. 52 of the 119 positive impulse response values (relative share: 43.7%) are statistically significant (68% error bands: 33; 90% error bands: 8; 95% error bands: 11), and 1 of the 5 negative impulse response values (relative share: 20%) is also statistically significant at 95% error bands. This means that 98.1% of the statistically significant impulse response values are positive.

The impulse response estimates for 19 of 35 categories (relative share: 54.3%) are (at least partially) statistically significant. When discriminating between categories with positive and negative impulse response estimates, 18 of 31 or 58.1% of the categories with positive estimates are statistically significant while 1 of 4 (or 25%) of the categories with negative estimates is statistically significant. This means that 94.7% of the statistically significant impulse response estimates are positive.

3. Variance Decomposition Analysis

The average relative share of volatility in the steel export variable that is due to variation in the oil price variable is 16% (moderate) for all categories included, 15.6% (moderate) for the categories with positive impulse responses, and 19.3% (moderate) for the categories with negative impulse responses.

The average relative variation in the steel export variable that can be explained by variation in the oil price variable is very low for 11 of the 35 categories (31.4%), low for 4 categories 11.4%), moderate for 8 categories (22.9%), high for 7 categories (20%), and very high for 5 categories (14.3%).

Comparing the average relative importance of the explanatory variables to the volatility of the steel export variable (oil price: 16%; steel import value: 12.3%; exchange rates: 9.6%; U.S. real GDP: 7.4%) shows that the oil price variable has the largest explanatory power of all explanatory variables. To put it differently, the oil price variable explains most of the variation in the steel export variable relative to the other explanatory variables for 12 of 35 or 34.3% of the categories analysed.

4. Granger Causality Analysis

The GC test results confirm the statistical usefulness or the predictive value of the oil price variable for the steel export variable for 15 of 35 categories (1% level: 6; 5% level: 5; 10% level: 4), a relative share of 42.9%.

5. Price Pattern Analysis

During the sample period, Canada exported significant volumes of steel to the U.S. in 28 of 29 low-value steel product categories (96.6%) and in 7 of 7 high-value categories (100%).

Following a one-standard deviation oil price shock, steel exports to the U.S. increase in 26 of 29 low-value steel product categories (89.7%) and in 6 of 7 high-value categories (85.7%).

On average, exports in low-value steel product categories increase for 3.4 months and exports in high-value categories increase for 3 months.

The impulse response estimates are statistically significant for 17 of 28 low-value steel product categories (60.7%) and for 2 of 7 high-value categories (28.6%)

The average relative volatility in the steel export variable that can be explained by variation in the oil price variable is 16.9% (moderate) for the low-value categories and 12.3% (moderate) for the high-value categories.

6. Conclusion

Impulse Responses and Variance Decomposition

A one-standard deviation shock in the oil price variable leads to increasing export volumes from Canada to the U.S. for 88.6% of the categories analysed. On average, steel exports to the U.S. increase for 3.3 months. When it comes to the relative share of positive and negative statistically significant impulse response values, 98.1% of the statistically significant values are positive. Moreover, 94.7% of the statistically significant impulse response estimates are also positive.

For the categories analysed, the average relative variation in the steel export variable that can be attributed to volatility in the oil price variable is moderate (22.9%), high (20%), or very high (14.3%) for the majority of the categories analysed (57.2%). This is an indicator for the significant explanatory power of the oil price variable for the steel export variable. Thereby, the average share of volatility in the steel export variable that is due to variation in the oil price variable for all categories analysed is 16% (moderate).

Summing up, there is evidence that Canadian steel exports to the U.S. are positively impacted by an oil price shock to a significant extent. The results are in line with the findings for total Canadian steel exports to the U.S. in section 6.2.4.1. Moreover, the variance decomposition estimates provide evidence for the explanatory power oil prices can have for steel trade volumes.

Price Patterns

The following findings provide evidence for the hypothesis that oil price shocks have a stronger impact on low-value steel trade than on high-value steel trade:

- The relative share of steel product categories for which significant volumes of steel have been exported from Canada to the U.S. during the sample period is larger for high-value exports (100%) than for low-value exports (96.6%).
- While export volumes from Canada to the U.S. increase for 89.7% of the low-value categories, export volumes increase for only 85.7% of the high-value categories (low-value products should profit overproportionally).
- The average increase of steel exports from Canada to the U.S. lasts longer for low-value exports (3.4 months) than for high-value exports (3 months) (low-value products should profit overproportionally).

- The relative share of statistically significant impulse response estimates is higher for low-value categories (60.7%) than for high-value categories (28.6%) (low-value products should profit overproportionally).
- On average, the explanatory power of the oil price variable for the steel export variable is higher for low-value categories (16.9%) than for high-value categories (12.3%).

The estimates support the hypothesis that low-value steel trade is impacted more by oil price shocks than high-value steel trade.

6.4.4.2 Mexico

Table 6.40 VEC Analysis - Mexico

Product Category	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
1A	1	30.111	29.6	0.37
	2	22.970		
	3	7.059		
1B	1	484.035	11.2	0.71
	2	4,728.556 *		
3	1	324.007	43.8	0.31
	2	1,532.540 ***		
	3	158.108		
	4	843.548 *		
4	1	251.755 ***	25.5	0.06
	2	14.183		
	3	163.947 **		
6A	1	0.791	32.0	0.00
6B	1	-334.121 *	8.1	0.16
	2	-282.270		
8	1	0.067	14.9	0.09
	2	0.057		
	3	0.158		
	4	0.134		
	5	0.261 *		
	6	0.126		
	7	0.046		
9	1	1.926	10.8	0.12
14	1	161.709 *	3.4	0.72
	2	3.795		
	3	45.385		
	4	72.002		

VEC Analysis - Mexico (continued)				
Product Category	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
14A	1	239.468 *	9.7	0.60
	2	151.729		
	3	260.475 *		
	4	315.491 *		
	5	427.388 *		
	6	355.204 *		
	7	213.858		
15	1	1,655.167 ***	5.0	0.08
16	1	-3.206	16.4	0.44
17	1	-3.089 *	21.1	0.15
	2	-1.303		
18	1	99.618	2.6	0.78
	2	237.332 **		
	3	28.001		
20	1	773.390 ***	45.1	0.00
	2	639.169 **		
	3	776.000 **		
	4	1,186.865 ***		
	5	652.993 *		
	6	321.576		
21A	1	199.136	10.2	0.16
	2	333.094 *		
	3	168.699		
	4	84.498		
21B	1	-5.762	18.0	0.00
21CD	1	5.141 *	10.9	0.38
	2	2.842		
	3	6.324 **		
	4	6.620 **		
	5	6.422 **		
	6	2.928		
	7	2.180		
	8	0.752		
21E	1	7.731	7.5	0.64
	2	3.163		
	3	3.645		
22A	1	112.729 *	8.0	0.14
	2	159.682 **		

VEC Analysis - Mexico (continued)				
Product Category	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
22B	1	-11.457 ***	13.4	< 0.01
	2	-9.523 ***		
	3	-13.752 ***		
	4	-11.308 ***		
	5	-3.972		
	6	-7.473 *		
23	1	142.117 *	52.4	0.00
	2	223.551 **		
	3	379.744 ***		
	4	82.379		
	5	119.181		
28	1	6.777	5.6	0.89
	2	3.884		
29	1	1.713	21.7	< 0.1
31	1	-596.501	12.0	0.01
	2	-1,442.106 *		
	3	-1,575.888 *		
	4	-1,945.791 *		
	5	-1,169.320		
32	1	317.390	2.7	0.62
	2	486.254		
	3	493.472		
	4	69.258		
	5	195.901		
	6	418.248		
33A	1	56.499	12.8	0.64
	2	135.666		
33B	1	1.502	12.9	0.00
	2	1.023		
	3	3.573		
	4	7.876 *		
	5	2.593		
	6	5.991		
	7	13.801 ***		
	8	8.821 *		
	9	1.343		
34	1	-374.417 *	3.4	0.27
	2	-342.234 *		

VEC Analysis - Mexico (continued)				
Product Category	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
35	1	3.144	25.9	0.00
	2	7.446 **		
	3	6.215 *		
36	1	-9.582	18.1	0.16
37	1	60.250 *	26.1	0.37
	2	40.078 *		
	3	78.434 ***		
	4	41.582 *		

Source:
Author's calculations (EViews®)

* statistically significant at 68% error bands
** statistically significant at 90% error bands
*** statistically significant at 95% error bands

1. Included and Excluded Steel Product Categories

The steel product category analysis for Mexico includes 32 of 36 categories. Four categories have been excluded from the analysis for the following reasons:

- exports to the U.S. during the sample period in less than ten months: 5, 7, 29a
- category sample includes one or more I(2) variables: 19

2. Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to increasing steel exports from Mexico to the U.S. in 24 of the 32 steel product categories analysed (75%) and to decreasing exports in the remaining 8 categories (25%).

The average immediate increase for the 32 categories lasts for 2.2 months. The average increase for the 24 categories with increasing export volumes lasts for 3.8 months while the average decrease for the 8 categories with decreasing export volumes lasts for 2.5 months.

50 of the 111 single impulse response values are statistically significant (relative share: 45%), 28 at 68% error bands, 10 at 90% error bands, and 12 at 95% error bands. 38 of the 91 positive impulse response values (relative share: 41.8%) are statistically significant (68% error bands: 20; 90% error bands: 10; 95% error bands: 8), and 12 of the 20 negative impulse response values (relative share: 60%) are also statistically significant (68% error bands: 8; 95% error bands: 4). This means that 76% of the statistically significant impulse response values are positive.

The impulse response estimates for 21 of 32 categories (relative share: 59.4%) are (at least partially) statistically significant. When discriminating between categories with positive and negative impulse response estimates, 16 of 24 or 66.7% of the categories with positive estimates are statistically significant while 5 of 8 or 62.5% of the categories with negative estimates are statistically significant. This means that 76.2% of the statistically significant impulse response estimates are positive.

3. Variance Decomposition Analysis

The average relative share of volatility in the steel export variable that is due to variation in the oil price variable is 16.9% (moderate) for all categories included, 17.9% (moderate) for the categories with positive impulse responses, and 13.8% (moderate) for the categories with negative impulse responses.

The average relative variation in the steel export variable that can be explained by variation in the oil price variable is very low for 4 of the 35 categories (12.5%), low for 6 categories (18.8%), moderate for 12 categories (37.5%), high for 6 categories (18.8%), and very high for 4 categories (12.5%).

Comparing the average relative importance of the explanatory variables to the volatility of the steel export variable (oil price: 16.9%; steel import value: 12.7%; exchange rates: 7.2%; U.S. real GDP: 6.2%) shows that the oil price variable has the largest explanatory power of all explanatory variables. To put it differently, the oil price variable explains most of the variation in the steel export variable relative to the other explanatory variables for 18 of 32 or 56.3% of the categories analysed.

4. Granger Causality Analysis

The GC test results confirm the statistical usefulness or the predictive value of the oil price variable for the steel export variable for 12 of 32 categories (1% level: 7; 5% level: 1; 10% level: 4), a relative share of 37.5%.

5. Price Pattern Analysis

During the sample period, Mexico exported significant volumes of steel to the U.S. in 25 of 29 low-value steel product categories (86.2%) and in 7 of 7 high-value categories (100%).

Following a one-standard deviation oil price shock, steel exports to the U.S. increase in 20 of 25 low-value steel product categories (75%) and in 4 of 7 high value categories (57.1%).

On average, exports in low-value steel product categories increase for 2.3 months and exports in high-value categories increase for 2 months.

The impulse response estimates are statistically significant for 17 of 25 low-value steel product categories (68%) and for 3 of 7 high-value categories (42.9%)

The average relative volatility in the steel export variable that can be explained by variation in the oil price variable is 16.4% (moderate) for the low-value categories and 18.4% (moderate) for the high-value categories.

6. Conclusion

Impulse Responses and Variance Decomposition

A one-standard deviation shock in the oil price variable leads to increasing steel export volumes from Mexico to the U.S. for 75% of the categories analysed. On average, steel exports to the U.S. increase for 2.2 months. When it comes to the relative share of positive and negative statistically significant impulse response values, 76% of the statistically significant values are positive. Moreover, 76.2% of the statistically significant impulse response estimates are also positive.

For the categories analysed, the average relative variation in the steel export variable that can be attributed to volatility in the oil price variable is moderate (37.5%), high (18.8%), or very high (12.5%) for two-thirds of the categories analysed (68.8%) which is an indicator for the significant explanatory power of the oil price variable for the steel export variable. Thereby, the average share of volatility in the steel export variable that is due to variation in the oil price variable for all categories analysed is 16.9% (moderate).

Summing up, there is evidence that Mexican steel exports to the U.S. are positively impacted by an oil price shock. The results are in line with the findings for total Mexican steel exports to the U.S. in section 6.2.4.7. Moreover, the variance decomposition estimates provide evidence for the explanatory power oil prices can have for steel trade volumes.

Price Patterns

The following findings provide evidence for the hypothesis that oil price shocks have a stronger impact on low-value steel trade than on high-value steel trade:

- The relative share of steel product categories for which significant volumes of steel have been exported from Mexico to the U.S. during the sample period is larger for high-value exports (100%) than for low-value exports (86.2%).
- While export volumes from Mexico to the U.S. increase for 75% of the low-value categories, export volumes increase for only 57.1% of the high-value categories.
- The average increase of steel exports from Mexico to the U.S. lasts longer for low-value exports (2.3 months) than for high-value exports (2 months).
- The relative share of statistically significant impulse response estimates is higher for low-value categories (68%) than for high-value categories (42.9%).

The following findings provide evidence against the hypothesis:

- On average, the explanatory power of the oil price variable for the steel export variable is higher for high-value categories (18.4%) than for low-value categories (16.4%).

The majority of the estimates support the hypothesis that low-value steel trade is impacted more by oil price shocks than high-value steel trade.

6.4.5 South America (Brazil)

For South America, Brazil has been selected for the analysis of steel exports to the U.S. by steel product category.

Table 6.41 VEC Analysis - Brazil

Product Category	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
1A	1	98.149	22.8	0.25
	2	19.250		
1B	1	2,349.430	30.7	0.66
3	1	682.640 *	13.1	0.67
	2	934.369 *		
4	1	-418.274 *	26.8	0.00
6A	1	21.793	4.3	0.00
	2	202.522 *		
6B	1	51.266 *	22.6	0.00
	2	116.883 ***		
	3	8.417		
	4	22.446		
	5	148.025 ***		
	6	38.932		
9	1	1.389 *	8.8	0.00
14	1	9.806	9.7	0.19
	2	10.348		
14A	1	25.611	12.6	< 0.01
15	1	-86.339	0.9	0.52
16	1	22.905 **	4.3	0.49
	2	6.388		
	3	18.719 **		
	4	15.810 **		
	5	10.335 *		
17	1	48.123 ***	29.2	0.00
	2	13.192		
	3	24.952 *		
	4	20.947 *		
	5	14.490		
18	1	-75.905 ***	20.6	0.22
19	1	39.220	10.7	0.48

VEC Analysis - Brazil (continued)				
Product Category	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
20	1	9.879	11.9	0.00
21A	1	161.337 ***	19.9	0.00
21B	1	-20.449 *	5.8	0.88
21CD	1	5.974 *	26.3	0.29
	2	2.874		
21E	1	0.095	1.3	0.00
22A	1	26.811 *	1.9	0.00
	2	43.819 *		
	3	19.928		
	4	44.781 *		
	5	15.997		
23	1	96.325 **	5.6	0.16
	2	50.495		
	3	27.779		
28	1	-5.102	12.8	0.00
29	1	56.423	14.5	0.65
	2	251.943 *		
	3	195.047		
29A	1	-21.772 *	3.6	0.64
31	1	143.171	0.1	0.57
33A	1	-3,012.083 ***	5.9	0.03
33B	1	61.075	10.5	0.35
34	1	123.802	14.3	0.20
	2	308.471		
	3	434.834 **		
35	1	-3.156 *	11.7	0.00
	2	-4.422 *		
36	1	4.059	13.6	0.68
	2	24.461 *		
	3	1.163		
	4	23.344 *		
	5	3.392		
37	1	-25.846	4.3	0.28

Source:
Author's calculations (EViews®)

* statistically significant at 68% error bands
** statistically significant at 90% error bands
*** statistically significant at 95% error bands

1. Included and Excluded Steel Product Categories

The steel product category analysis for Brazil includes 31 of 36 categories. Five categories have been excluded from the analysis for the following reasons:

- no exports to the U.S. during the sample period: 5, 7
- exports to the U.S. during the sample period in less than ten months: 8, 22b, 32

2. Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to increasing steel exports from Brazil to the U.S. in 22 of the 31 steel product categories analysed (71%) and to decreasing exports in 9 categories (29%).

The average immediate increase for the 31 categories lasts for 1.4 months. The average increase for the 22 categories with increasing export volumes lasts for 2.5 months while the average decrease for the 9 categories with decreasing export volumes lasts for 1.1 months.

31 of the 64 single impulse response values are statistically significant (relative share: 48.4%), 20 at 68% error bands, 5 at 90% error bands, and 6 at 95% error bands. 24 of the 54 positive impulse response values (relative share: 44.4%) are statistically significant (68% error bands: 15; 90% error bands: 5; 95% error bands: 4), and 7 of the 10 negative impulse response values (relative share: 70%) are also statistically significant (68% error bands: 5; 95% error bands: 2). This means that 77.4% of the statistically significant impulse response values are positive.

The impulse response estimates for 19 of 31 categories (relative share: 61.3%) are (at least partially) statistically significant. When discriminating between categories with positive and negative impulse response estimates, 13 of 22 or 59.1% of the categories with positive estimates are statistically significant while 6 of 9 or 66.7% of the categories with negative estimates are statistically significant. This means that 68.4% of the statistically significant impulse response estimates are positive.

3. Variance Decomposition Analysis

The average relative share of volatility in the steel export variable that is due to variation in the oil price variable is 12.3% (moderate) for all categories included, 13.1% (moderate) for the categories with positive impulse responses, and 10.3% (moderate) for the categories with negative impulse responses.

The average relative variation in the steel export variable that can be explained by variation in the oil price variable is very low for 8 of the 31 categories (25.8%), low for 5 categories (16.1%), moderate for 11 categories (35.5%), high for 6 categories (19.4%), and very high for 1 category (3.2%).

Comparing the average relative importance of the explanatory variables to the volatility of the steel export variable (oil price: 12.3%; steel import value: 14.1%; exchange rates: 6.4%; U.S. real GDP: 7.9%) shows that the oil price variable has the second-largest explanatory power of all explanatory variables. To put it differently, the oil price variable explains most of the variation in the steel export variable relative to the other explanatory variables for 11 of 31 or 35.5% of the categories analysed.

4. Granger Causality Analysis

The GC test results confirm the statistical usefulness or the predictive value of the oil price variable for the steel export variable for 13 of 31 categories (1% level: 12; 5% level: 1), a relative share of 41.9%.

5. Price Pattern Analysis

During the sample period, Brazil exported significant volumes of steel to the U.S. in 24 of 29 low-value steel product categories (82.7%) and in 7 of 7 high-value categories (100%).
Following a one-standard deviation oil price shock, steel exports to the U.S. increase in 17 of 24 low-value steel product categories (70.8%) and in 5 of 7 high value categories (71.4%).
On average, exports in low-value steel product categories increase for 1.9 months and exports in high-value categories increase for 1.6 months.
The impulse response estimates are statistically significant for 15 of 24 low-value steel product categories (62.5%) and for 4 of 7 high-value categories (57.1%)
The average relative volatility in the steel export variable that can be explained by variation in the oil price variable is 12% (moderate) for the low-value categories and 13.4% (moderate) for the high value categories.

6. Conclusion

Impulse Responses and Variance Decomposition

A one-standard deviation shock in the oil price variable leads to increasing export volumes from Brazil to the U.S. for 71% of the categories analysed. On average, steel exports to the U.S. increase for 1.4 months. When it comes to the relative share of positive and negative statistically significant impulse response values, 77.4% of the statistically significant values are positive. Moreover, 68.4% of the statistically significant impulse response estimates are also positive.
For the categories analysed, the average relative variation in the steel export variable that can be attributed to volatility in the oil price variable is moderate (35.5%), high (19.4%), or very high (3.2%) for the majority of the categories analysed (58.1%) which is an indicator for the significant explanatory power of the oil price variable for the steel export variable. Thereby,

the average share of volatility in the steel export variable that is due to variation in the oil price variable for all categories analysed is 12.3% (moderate).

Summing up, there is evidence that Brazilian steel exports to the U.S. are positively impacted by an oil price shock. The results are in line with the findings for total Brazilian steel exports to the U.S. in section 6.2.5.2. Moreover, the variance decomposition estimates provide evidence for the explanatory power oil prices can have for steel trade volumes.

Price Patterns

The following findings provide evidence for the hypothesis that oil price shocks have a stronger impact on low-value steel trade than on high-value steel trade:

- The relative share of steel product categories for which significant volumes of steel have been exported from Brazil to the U.S. during the sample period is larger for high-value exports (100%) than for low-value exports (82.7%).
- The average increase of steel exports from Brazil to the U.S. lasts longer for low-value exports (1.9 months) than for high-value exports (1.6 months).
- The relative share of statistically significant impulse response estimates is higher for low-value categories (62.5%) than for high-value categories (57.1%).

The following findings provide evidence against the hypothesis:

- While export volumes from Brazil to the U.S. increase for 71.4% of the high-value categories, export volumes increase for only 70.8% of the low-value categories.
- On average, the explanatory power of the oil price variable for the steel export variable is higher for high-value categories (13.4%) than for low-value categories (12%).

The estimates provide mixed evidence. Therefore, no definite statement can be made with regard to possible price patterns. By tendency, the evidence found that supports the hypothesis of price patterns is somewhat stronger than the evidence contradicting the hypothesis.

6.4.6 Africa (South Africa)

For Africa, South Africa has been selected for the analysis of steel exports to the U.S. by steel product category.

Table 6.42 VEC Analysis – South Africa

Product Category	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
1B	1	-35.356	9.6	0.69
3	1	-108.543	12.0	0.69
	2	-1.459		
4	1	222.548	21.9	0.27
	2	502.480 **		
6A	1	-73.392	5.4	0.62
6B	1	91.686	1.3	0.89
14	1	-93.409	1.6	0.80
	2	-60.871		
	3	-119.298		
16	1	-4.886	7.5	0.80
18	1	-128.219 *	10.3	0.22
19	1	-227.864 ***	20.3	0.51
	2	-48.664		
	3	-12.077		
20	1	-82.781	7.23	0.71
21A	1	-15.206	19.3	0.60
21CD	1	-0.569	2.2	0.84
	2	-7.314		
21E	1	-6.145	3.0	0.71
	2	-0.267		
22A	1	-9.805 *	15.1	0.06
22B	1	-12.298	1.3	0.30
23	1	-16.983	38.0	0.33
	2	-38.772		
31	1	-334.104	7.3	0.65
	2	-56.604		
32	1	-559.950 *	16.8	0.02
	2	-646.078 *		

VEC Analysis - South Africa (continued)				
Product Category	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
33A	1	-85.178	1.7	0.79
	2	-387.774		
	3	-335.519		
	4	-187.419		
	5	-81.340		
	6	-32.325		
	7	-12.650		
37	1	-1.734 *	36.2	0.27

Source:
Author's calculations (EViews®)

* statistically significant at 68% error bands
** statistically significant at 90% error bands
*** statistically significant at 95% error bands

1. Included and Excluded Steel Product Categories

The steel product category analysis for South Africa includes 20 of 36 categories. 16 categories have been excluded from the analysis for the following reasons:

- no exports to the U.S. during the sample period: 7, 8, 29, 29a, 33b, 34, 35
- exports to the U.S. during the sample period in less than ten months: 1a, 5, 9, 14a, 15, 17, 21b, 28, 36

2. Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to decreasing steel exports from South Africa to the U.S. in 18 of the 20 steel product categories analysed (90%) and to increasing exports in 2 categories (10%).

The average immediate decline for the 20 categories lasts for 1.6 months. The average decline for the 18 categories with decreasing export volumes lasts for 1.9 months while the average increase for the 2 categories with increasing export volumes lasts for 1.5 months.

Seven of the 37 single impulse response values are statistically significant (relative share: 18.9%), 5 at 68% error bands, 1 at 90% error bands, and 1 at 95% error bands. Six of the 34 negative impulse response values (relative share: 17.6%) are statistically significant (68% error bands: 5; 95% error bands: 1), and 1 of 3 or 33.3% of the positive impulse response values is statistically significant. This means that 85.7% of the statistically significant impulse response values are negative.

The impulse response estimates for 6 of 20 categories (relative share: 30%) are (at least partially) statistically significant. When discriminating between categories with positive and negative impulse response estimates, 5 of 18 or 27.8% of the categories with negative estimates are statistically also significant while 1 of the 2 categories with positive estimates (relative share: 50%) is statistically significant. This means that 83.3% of the statistically significant impulse response estimates are also negative.

3. Variance Decomposition Analysis

The average relative share of volatility in the steel export variable that is due to variation in the oil price variable is 11.9% (moderate) for all categories included, 11.6% (moderate) for the categories with positive impulse responses, and 12% (moderate) for the categories with negative impulse responses.

The average relative variation in the steel export variable that can be explained by variation in the oil price variable is very low for 6 of the 20 categories (30%), low for 5 categories (25%), moderate for 5 categories (25%), high for 2 categories (10%), and very high for 2 categories (10%).

Comparing the average relative importance of the explanatory variables to the volatility of the steel export variable (oil price: 11.9%; steel import value: 9.8%; exchange rates: 7.2%; U.S. real GDP: 6.2%) shows that the oil price variable has the largest explanatory power of all explanatory variables. To put it differently, the oil price variable explains most of the variation in the steel export variable relative to the other explanatory variables for 10 of 20 or 50% of the categories analysed.

4. Granger Causality Analysis

The GC test results confirm the statistical usefulness or the predictive value of the oil price variable for the steel export variable for 2 of 20 categories, 1 at the 5% level and 1 at the 10% level, a relative share of 10%.

5. Price Pattern Analysis

During the sample period, South Africa exported significant volumes of steel to the U.S. in 16 of 29 low-value steel product categories (55.2%) and in 4 of 7 high-value categories (57.1%).

Following a one-standard deviation oil price shock, steel exports to the U.S. decrease in 14 of 16 low-value steel product categories (87.5%) and in 4 of 4 high value categories (100%).

On average, exports in low-value steel product categories decrease for 1.6 months and exports in high-value categories decline for 1.5 months.

The impulse response estimates are statistically significant for 5 of 16 low-value steel product categories (31.3%) and for 1 of 4 high-value categories (25%)

The average relative volatility in the steel export variable that can be explained by variation in the oil price variable is 11.8% (moderate) for the low-value categories and 12.3% (moderate) for the high-value categories.

6. Conclusion

Impulse Responses and Variance Decomposition

A one-standard deviation shock in the oil price variable leads to decreasing export volumes from South Africa to the U.S. for 90% of the categories analysed. On average, the steel exports to the U.S. decline for 1.6 months. When it comes to the relative share of positive and negative statistically significant impulse response values, 85.7% of the statistically significant values are negative. Moreover, 83.3% of the statistically significant impulse response estimates are also negative.

For the categories analysed, the average relative variation in the steel export variable that can be attributed to volatility in the oil price variable is moderate (25%), high (10%), or very high (10%) for a strong minority of the categories analysed (45%) which is an indicator for the significant explanatory power of the oil price variable for the steel export variable. Thereby, the average share of volatility in the steel export variable that is due to variation in the oil price variable for all categories analysed is 11.9% (moderate).

Recapitulatory, there is evidence that South African steel exports to the U.S. are negatively impacted by an oil price shock. The results are in line with the findings for total South African steel exports to the U.S. in section 6.2.6.3. Moreover, the variance decomposition estimates provide evidence for the explanatory power oil prices can have for steel trade volumes.

Price Patterns

The following findings provide evidence for the hypothesis that oil price shocks have a stronger impact on low-value steel trade than on high-value steel trade:

- The relative share of steel product categories for which significant volumes of steel have been exported from South Africa to the U.S. during the sample period is larger for high-value exports (57.1%) than for low-value exports (55.2%).
- The average decline of steel exports from South Africa to the U.S. lasts longer for low-value exports (1.6 months) than for high-value exports (1.5 months).
- The relative share of statistically significant impulse response estimates is higher for low-value categories (31.3%) than for high-value categories (25%).

The following findings provide evidence against the hypothesis:

- While export volumes from South Africa to the U.S. decline for 100% of the high-value categories, export volumes decline for only 87.5% of the low-value categories.

- On average, the explanatory power of the oil price variable for the steel export variable is higher for high-value categories (12.3%) than for low-value categories (11.8%).

The estimates provide mixed evidence. Therefore, no definite statement can be made with regard to possible price patterns. By tendency, the evidence found that supports the hypothesis of price patterns is somewhat stronger than the evidence contradicting the hypothesis.

6.4.7 Middle East (Turkey)

For the Middle East, Turkey has been selected for the analysis of steel exports to the U.S. by steel product category.

Table 6.43 VEC Analysis - Turkey

Product Category	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
1B	1	-951.638 *	20.0	0.06
	2	-101.633		
3	1	-488.319	7.9	0.60
	2	-42.909		
	3	-1,562.088		
	4	-1,532.036		
4	1	-55.260	14.2	0.81
	2	-118.417 *		
	3	-3.845		
6A	1	-55.990 *	14.1	0.40
6B	1	-2,904.966 ***	54.1	< 0.01
	2	-6,478.917 ***		
	3	-6,950.641 ***		
	4	-7,102.454 ***		
	5	-1,570.272		
14	1	285.504	7.7	0.25
14A	1	32.737	4.2	0.45
	2	1.718		
15	1	-1,641.575	24.1	0.63
	2	-4,944.177 *		
	3	-2,071.761		
	4	-2,000.815		

VEC Analysis - Turkey (continued)				
Product Category	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
16	1	5.773	7.6	0.66
17	1	5.599	12.6	0.47
	2	4.801		
18	1	153.021	9.7	0.38
19	1	-100.054	16.5	0.64
	2	-103.301		
	3	-475.354 **		
	4	-7.829		
	5	-16.137		
	6	-524.882 **		
	7	-230.925		
	8	-241.046		
21A	1	105.433	12.2	0.28
21B	1	-0.118	4.0	0.45
	2	-0.120		
21CD	1	-0.446	6.0	0.04
	2	-2.057 *		
22A	1	-84.239	2.9	0.48
	2	-94.394		
	3	-361.920 *		
	4	-312.302		
	5	-97.187		
23	1	-1.519	37.2	0.04
31	1	-1,860.744 *	6.7	0.24
	2	-730.705		
32	1	-191.689	9.8	0.72
33A	1	-124.050	14.1	0.76
	2	-277.775		
	3	-121.877		
	4	-175.755		
36	1	-8.207	12.8	0.87
37	1	-1.241 ***	15.5	< 0.01
	2	-1.632 ***		
	3	-1.437 ***		
	4	-0.116		

Source:
Author's calculations (EViews®)

* statistically significant at 68% error bands
** statistically significant at 90% error bands
*** statistically significant at 95% error bands

1. Included and Excluded Steel Product Categories

The steel product category analysis for Turkey includes 22 of 36 categories. 14 categories have been excluded from the analysis for the following reasons:

- no exports to the U.S. during the sample period: 5, 7, 8, 9, 21e, 22b, 33b, 35
- exports to the U.S. during the sample period in less than ten months: 1a, 28, 29, 29a, 34
- VEC matrix not positive definite: 20

2. Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to decreasing steel exports from Turkey to the U.S. in 16 of the 22 steel product categories analysed (72.7%) and to increasing exports in 6 of the 22 categories (27.3%).

The average immediate decline for the 22 categories lasts for 1.9 months. The average decline for the 16 categories with decreasing export volumes lasts for 3.1 months while the average increase for the 6 categories with increasing export volumes lasts for 1.3 months.

16 of the 58 single impulse response values are statistically significant (relative share: 27.6%), 7 at 68% error bands, 2 at 90% error bands, and 7 at 95% error bands. 16 of the 50 negative impulse response values (relative share: 32%) are statistically significant (68% error bands: 7; 90% error bands: 2; 95% error bands: 7), and none of the 8 positive impulse response values is statistically significant. This means that 100% of the statistically significant impulse response values are negative.

The impulse response estimates for 10 of 22 categories (relative share: 45.5%) are (at least partially) statistically significant. When discriminating between categories with positive and negative impulse response estimates, 10 of 16 or 62.5% of the categories with negative estimates are statistically significant while none of the 6 categories with positive estimates is statistically significant. This means that 100% of the statistically significant impulse response estimates are negative.

3. Variance Decomposition Analysis

The average relative share of volatility in the steel export variable that is due to variation in the oil price variable is 14.3% (moderate) for all categories included, 16.3% (moderate) for the categories with negative impulse responses, and 9% (low) for the categories with positive impulse responses.

The average relative variation in the steel export variable that can be explained by variation in the oil price variable is very low for 3 of the 22 categories (13.6%), low for 7 categories (31.8%), moderate for 8 categories (36.4%), high for 2 categories (9.1%), and very high for 2 categories (9.1%).

Comparing the average relative importance of the explanatory variables to the volatility of the steel export variable (oil price: 14.3%; steel import value: 13.7%; exchange rates: 7.8%; U.S. real GDP: 6.5%) shows that the oil price variable has the largest explanatory power of all explanatory variables. To put it differently, the oil price variable explains most of the variation in the steel export variable relative to the other explanatory variables for 9 of 22 or 40.9% of the categories analysed.

4. Granger Causality Analysis

The GC test results confirm the statistical usefulness or the predictive value of the oil price variable for the steel export variable for 5 of 22 categories (1% level: 2; 5% level: 2; 10% level: 1), a relative share of 22.7%.

5. Price Pattern Analysis

During the sample period, Turkey exported significant volumes of steel to the U.S. in 17 of 29 low-value steel product categories (58.6%) and in 5 of 7 high-value categories (71.4%).
Following a one-standard deviation oil price shock, steel exports to the U.S. decrease in 13 of 17 low-value steel product categories (76.4%) and in 3 of 5 high-value categories (60%).
On average, exports in low-value steel product categories decrease for 2.1 months and exports in high-value categories decline for 1 month.
The impulse response estimates are statistically significant for 8 of 17 low-value steel product categories (47.1%) and for 2 of 5 high-value categories (40%).
The average relative volatility in the steel export variable that can be explained by variation in the oil price variable is 15.8% (moderate) for the low-value categories and 9.1% (low) for the high value categories.

6. Conclusion

Impulse Responses and Variance Decomposition

A one-standard deviation shock in the oil price variable leads to decreasing export volumes from Turkey to the U.S. for 72.3% of the categories analysed. On average, steel exports to the U.S. decline for 1.9 months. When it comes to the relative share of positive and negative statistically significant impulse response values, 100% of the statistically significant impulse response values and impulse response estimates are negative.
For the categories analysed, the average relative variation in the steel export variable that can be attributed to volatility in the oil price variable is moderate (36.4%), high (9.1%), or very high (9.1%) for the majority of the categories analysed (54.6%) which is an indicator for the significant explanatory power of the oil price variable for the steel export variable. Thereby,

the average share of volatility in the steel export variable that is due to variation in the oil price variable for all categories analysed is 14.3% (moderate).

Summing up, there is strong evidence that Turkish steel exports to the U.S. are negatively impacted by an oil price shock. The results are in line with the findings for total Turkish steel exports to the U.S. in section 6.2.7.3. Moreover, the variance decomposition estimates provide evidence for the explanatory power oil prices can have for steel trade volumes.

Price Patterns

The following findings provide evidence for the hypothesis that oil price shocks have a stronger impact on low-value steel trade than on high-value steel trade:

- The relative share of steel product categories for which significant volumes of steel have been exported from Turkey to the U.S. during the sample period is larger for high-value exports (71.4%) than for low-value exports (58.6%).
- While export volumes from Turkey to the U.S. decline for 76.4% of the low-value categories, export volumes decline for only 60% of the high-value categories.
- The average decline of steel exports from Turkey to the U.S. lasts longer for low-value exports (2.1 months) than for high-value exports (1 month).
- The relative share of statistically significant impulse response estimates is higher for low-value categories (47.1%) than for high-value categories (40%).
- On average, the explanatory power of the oil price variable for the steel export variable is higher for low-value categories (12.3%) than for high-value categories (9.1%).

The estimates support the hypothesis that low-value steel trade is impacted more by oil price shocks than high-value steel trade.

6.4.8 Asia

For Asia, China (6.4.8.1), Japan (6.4.8.2), South Korea (6.4.8.3), and Taiwan (6.4.8.4) have been selected for the analysis of steel exports to the U.S. by steel product category.

6.4.8.1 China

Table 6.44 VEC Analysis - China

Product Category	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
1A	1	-0.683	17.8	< 0.01
	2	-1.368 *		
	3	-1.425 *		
	4	-4.005 ***		
	5	-1.649 *		
	6	-1.880 **		
1B	1	-492.778	14.9	0.54
3	1	-4,803.740 *	9.3	0.32
	2	-5,000.146 *		
	3	-2,518.214		
	4	-3,269.433		
	5	-2,140.371		
4	1	-549.913 *	33.5	0.46
	2	-133.884		
	3	-150.150		
	4	-1,555.393 ***		
	5	-336.251		
	6	-764.395 **		
	7	-675.844 *		
	8	-441.436		
5	1	-0.373	16.9	0.66
	2	-0.374		
	3	-0.168		
6A	1	-623.852 *	9.6	0.68
6B	1	-83.784	0.2	0.68
7	1	-9.449	6.1	0.00
	2	-13.472 *		
8	1	-321.443 ***	24.1	0.00
	2	-171.735 *		
9	1	-2.905	15.6	0.00

VEC Analysis - China (continued)				
Product Category	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
14A	1	-135.180 ***	36.4	0.00
	2	-173.826 ***		
	3	-150.895 ***		
	4	-173.085 ***		
	5	-154.069 ***		
	6	-0.835		
15	1	-186.793	3.4	0.00
	2	-246.307		
	3	-418.274		
	4	-695.445		
16	1	-174.029 ***	43.8	0.05
	2	-155.888 ***		
	3	-164.274 ***		
17	1	-12.899	8.5	0.87
18	1	442.402	8.6	0.70
20	1	-999.475 **	19.1	0.00
	2	-1,270.831 ***		
21A	1	-161.467	4.7	0.52
	2	-642.468 **		
	3	-593.868 *		
	4	-656.531 *		
	5	-511.236 *		
	6	-447.418		
	7	-299.971		
	8	-188.753		
	9	-30.800		
21B	1	-25.033	38.0	0.00
	2	-11.306		
21CD	1	8.475	1.2	0.00
21E	1	3.799	2.9	0.40
	2	8.248		
22A	1	-53.417	16.1	0.00
	2	-180.112 *		
	3	-260.139 *		
	4	-69.335		
	5	-230.791 *		
	6	-163.150		
	7	-38.086		
	8	-26.929		
22B	1	-37.066 *	10.4	0.00
23	1	-165.754 *	40.1	< 0.05

VEC Analysis - China (continued)				
Product Category	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
28	1	-11.932	1.2	0.81
	2	-20.702		
29	1	-0.605	10.5	0.72
	2	-121.789 *		
	3	-74.316		
	4	-83.932		
	5	-46.363		
	6	-13.343		
31	1	-204.158	1.2	0.14
32	1	-1,105.519 *	2.8	0.47
	2	-409.123		
33A	1	-742.969	17.8	0.51
	2	-386.439		
33B	1	-27.574	3.0	0.45
	2	-3.877		
35	1	-9.792	6.9	0.02
	2	-14.101		
36	1	3.014	18.6	0.00
37	1	-7.780	2.9	0.00

Source:
Author's calculations (EViews®)

* statistically significant at 68% error bands
** statistically significant at 90% error bands
*** statistically significant at 95% error bands

1. Included and Excluded Steel Product Categories

The steel product category analysis for China includes 32 of 36 categories. Four categories have been excluded from the analysis for the following reasons:

- exports to the U.S. during the sample period in less than ten months: 29a
- category sample includes one or more I(2) variables: 14, 19
- VEC matrix not positive definite: 34

2. Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to decreasing steel exports from China to the U.S. in 28 of the 32 steel product categories analysed (87.5%) and to increasing exports in 4 of the 32 categories (12.5%).

The average immediate decline for the 32 categories lasts for 2.5 months. The average decline for the 28 categories with decreasing export volumes lasts for 3 months while the average increase for the 4 categories with increasing export volumes lasts for 1.3 months.

36 of the 90 single impulse response values are statistically significant (relative share: 40%), 20 at 68% error bands, 4 at 90% error bands, and 12 at 95% error bands. 36 of the 85 negative impulse response values (relative share: 42.4%) are statistically significant (68% error bands: 20; 90% error bands: 4; 95% error bands: 12), and none of the 5 positive impulse response values is statistically significant. This means that 100% of the statistically significant impulse response values are negative.

The impulse response estimates for 15 of 32 categories (relative share: 46.9%) are (at least partially) statistically significant. When discriminating between categories with positive and negative impulse response estimates, 15 of 28 or 53.6% of the categories with negative estimates are statistically significant while none of the 5 categories with positive estimates are statistically significant. This means that 100% of the statistically significant impulse response estimates are negative.

3. Variance Decomposition Analysis

The average relative share of volatility in the steel export variable that is due to variation in the oil price variable is 13.9% (moderate) for all categories included, 14.8% (moderate) for the categories with negative impulse responses, and 7.8% (low) for the categories with positive impulse responses.

The average relative variation in the steel export variable that can be explained by variation in the oil price variable is very low for 10 of the 32 categories (31.3%), low for 6 categories (18.8%), moderate for 10 categories (31.3%), high for 1 category (3.1%), and very high for 5 categories (15.6%).

Comparing the average relative importance of the explanatory variables to the volatility of the steel export variable (oil price: 13.9%; steel import value: 16%; exchange rates: 10.4%; U.S. real GDP: 4.7%) shows that the oil price variable has the second-largest explanatory power of all explanatory variables. To put it differently, the oil price variable explains most of the variation in the steel export variable relative to the other explanatory variables for 10 of 32 or 31.3% of the categories analysed.

4. Granger Causality Analysis

The GC test results confirm the statistical usefulness or the predictive value of the oil price variable for the steel export variable for 16 of 32 categories (1% level: 13; 5% level: 2; 10% level: 1), a relative share of 50%.

5. Price Pattern Analysis

During the sample period, China exported significant volumes of steel to the U.S. in 25 of 29 low-value steel product categories (86.2%) and in 7 of 7 high-value categories (100%).

Following a one-standard deviation oil price shock, steel exports to the U.S. decrease in 23 of 25 low-value steel product categories (92%) and in 5 of 7 high-value categories (71.4%).

On average, exports in low-value steel product categories decrease for 2.8 months and exports in high-value categories decline for 1.4 months.

The impulse response estimates are statistically significant for 12 of 25 low-value steel product categories (48%) and for 2 of 7 high-value categories (28.6%).

The average relative volatility in the steel export variable that can be explained by variation in the oil price variable is 13.2% (moderate) for the low-value categories and 16.5% (moderate) for the high-value categories.

6. Conclusion

Impulse Responses and Variance Decomposition

A one-standard deviation shock in the oil price variable leads to decreasing export volumes from China to the U.S. for 87.5% of the categories analysed. On average, steel exports to the U.S. decline for 2.5 months. When it comes to the relative share of positive and negative statistically significant impulse response values, 100% of the statistically significant values and the statistically significant impulse response estimates are negative.

For the categories analysed, the average relative variation in the steel export variable that can be attributed to volatility in the oil price variable is moderate (31.3%), high (3.1%), or very high (15.6%) for half of the categories analysed (50%). This is an indicator for the significant explanatory power of the oil price variable for the steel export variable. Thereby, the average share of volatility in the steel export variable that is due to variation in the oil price variable for all categories analysed is 13.9% (moderate).

Summing up, there is evidence that Chinese steel exports to the U.S. are negatively impacted by an oil price shock. The results are in line with the findings for total Chinese steel exports to the U.S. in section 6.2.8.1. Moreover, the variance decomposition estimates provide evidence for the explanatory power oil prices can have for steel trade volumes.

Price Patterns

The following findings provide evidence for the hypothesis that oil price shocks have a stronger impact on low-value steel trade than on high-value steel trade:

- The relative share of steel product categories for which significant volumes of steel have been exported from China to the U.S. during the sample period is larger for high-value exports (100%) than for low-value exports (86.2%).

- While export volumes from China to the U.S. decline for 92% of the low-value categories, export volumes decline for only 71.4% of the high-value categories.
- The average decline of steel exports from China to the U.S. lasts longer for low-value exports (2.8 months) than for high-value exports (1.4 months).
- The relative share of statistically significant impulse response estimates is higher for low-value categories (48%) than for high-value categories (28.6%).

The following findings provide evidence against the hypothesis:

- On average, the explanatory power of the oil price variable for the steel export variable is higher for high-value categories (16.5%) than for low-value categories (13.2%).

The majority of the estimates support the hypothesis that low-value steel trade is impacted more by oil price shocks than high-value steel trade.

6.4.8.2 Japan

Table 6.45 VEC Analysis - Japan

Product Category	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
1A	1	-38.972 **	2.3	0.00
1B	1	-2,197.656 **	15.6	0.28
	2	-2,938.717 *		
3	1	400.992 *	10.9	0.49
	2	326.523 *		
	3	469.595 **		
4	1	116.492	5.2	0.03
5	1	19.669 ***	25.3	0.00
6A	1	-25.041	6.8	0.89
	2	-3.201		
	3	-220.321 *		
	4	-258.150 *		
7	1	-216.517	18.5	< 0.05
8	1	18.623	31.7	0.30
	2	25.940 *		
14	1	3.539	6.3	0.31
14A	1	-12.192	10.2	0.08
	2	-63.231		

VEC Analysis - Japan (continued)				
Product Category	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
15	1	1,170.285	0.7	0.30
16	1	-7.068	5.7	0.88
	2	-3.902		
	3	-7.020		
17	1	-37.790	29.9	0.05
	2	-53.105		
18	1	-95.245	9.6	0.00
	2	-185.069 *		
	3	-202.740 *		
	4	-221.691 *		
	5	-176.544		
19	1	-277.254 *	15.8	0.27
	2	-269.243 *		
20	1	354.208	3.0	0.26
	2	1,516.131 **		
	3	483.137		
	4	862.533		
21A	1	-3.023	5.7	0.61
	2	-69.353		
	3	-0.416		
21B	1	28.181 *	11.0	< 0.01
	2	104.702 ***		
	3	40.952 *		
21CD	1	-37.332	23.2	0.86
	2	-37.069		
	3	-70.062 *		
	4	-5.217		
21E	1	22.631 *	14.4	0.00
	2	23.650 *		
22A	1	53.156	5.4	0.31
22B	1	-10.970	2.4	0.19
	2	-6.498		
	3	-2.361		
	4	-43.357		
	5	-17.375		
23	1	-2.950	17.3	0.79
28	1	-118.265	16.3	0.67
29	1	152.732 *	38.8	0.82
29A	1	-6.635	10.4	0.00
	2	-175.929 *		
	3	-123.629		

VEC Analysis - Japan (continued)				
Product Category	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
31	1	-147.649	7.1	0.19
	2	-75.187		
	3	-148.911		
	4	-248.255 *		
	5	-46.001		
32	1	-461.446 *	21.2	0.06
	2	-62.783		
	3	-480.054		
	4	-278.498		
33A	1	529.913 ***	15.5	0.00
33B	1	-13.254	50.8	0.00
	2	-2.445		
34	1	-56.564 *	39.0	0.13
	2	-50.087 *		
	3	-20.417		
	4	-64.139 *		
	5	-10.171		
35	1	-116.820	8.3	0.37
	2	-28.290		
	3	-164.197 *		
	4	-89.150		
	5	-205.849 ***		
	6	-59.489		
36	1	-11.439 *	24.0	0.01
	2	-5.766		
37	1	-19.920 *	14.2	< 0.01
	2	-17.417 *		
	3	-32.087 **		
	4	-14.601		

Source:
Author's calculations (EViews®)

* statistically significant at 68% error bands
** statistically significant at 90% error bands
*** statistically significant at 95% error bands

1. Included and Excluded Steel Product Categories

The steel product category analysis for Japan includes 34 of 36 categories. Two categories have been excluded from the analysis for the following reasons:

- exports to the U.S. during the sample period in less than ten months: 9
- VEC matrix is near singular matrix: 6b.

2. Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to decreasing steel exports from Japan to the U.S. in 22 of the 34 steel product categories analysed (64.7%) and to increasing exports in 12 of the 32 categories (35.3%).

The average immediate decline for the 34 categories lasts for 1.4 months. The average decline for the 22 categories with decreasing export volumes lasts for 3.1 months while the average increase for the 12 categories with increasing export volumes lasts for 1.7 months.

36 of the 87 single impulse response values are statistically significant (relative share: 41.4%), 27 at 68% error bands, 5 at 90% error bands, and 4 at 95% error bands. 23 of the 67 negative impulse response values (relative share: 34.3%) are statistically significant (68% error bands: 19; 90% error bands: 3; 95% error bands: 1), and 13 of the 20 positive impulse response values are also statistically significant (65%). This means that 63.9% of the statistically significant impulse response values are negative.

The impulse response estimates for 21 of 34 categories (relative share: 61.8%) are (at least partially) statistically significant. When discriminating between categories with positive and negative impulse response estimates, 13 of 22 or 59.1% of the categories with negative estimates are statistically significant while 8 of 12 or 75% of the categories with positive estimates are statistically significant. This means that 61.9% of the statistically significant impulse response estimates are negative.

3. Variance Decomposition Analysis

The average relative share of volatility in the steel export variable that is due to variation in the oil price variable is 15.4% (moderate) for all categories included, 16.1% (moderate) for the categories with negative impulse responses, and 14% (moderate) for the categories with positive impulse responses.

The average relative variation in the steel export variable that can be explained by variation in the oil price variable is very low for 4 of the 34 categories (11.8%), low for 9 categories (26.5%), moderate for 12 categories (35.3%), high for 5 categories (14.7%), and very high for 4 categories (11.8%).

Comparing the average relative importance of the explanatory variables to the volatility of the steel export variable (oil price: 15.4%; steel import value: 13.2%; exchange rates: 9.8%; U.S. real GDP: 6.5%) shows that the oil price variable has the largest explanatory power of all explanatory variables. To put it differently, the oil price variable explains most of the variation in the steel export variable relative to the other explanatory variables for 15 of 34 or 44.1% of the categories analysed.

4. Granger Causality Analysis

The GC test results confirm the statistical usefulness or the predictive value of the oil price variable for the steel export variable for 15 of 34 categories (1% level: 9; 5% level: 3; 10% level: 3), a relative share of 44.1%.

5. Price Pattern Analysis

During the sample period, Japan exported significant volumes of steel to the U.S. in 27 of 29 low-value steel product categories (93.1%) and in 7 of 7 high-value categories (100%).
Following a one-standard deviation oil price shock, steel exports to the U.S. decrease in 17 of 27 low-value steel product categories (63%) and in 5 of 7 high-value categories (71.4%).
On average, exports in low-value steel product categories decrease for 1.4 months and exports in high-value categories decline for 1 month.
The impulse response estimates are statistically significant for 15 of 27 low-value steel product categories (55.6%) and for 5 of 7 high-value categories (71.4%).
The average relative volatility in the steel export variable that can be explained by variation in the oil price variable is 15.6% (moderate) for the low-value categories and 14.4% (moderate) for the high-value categories.

6. Conclusion

Impulse Responses and Variance Decomposition

A one-standard deviation shock in the oil price variable leads to decreasing export volumes from Japan to the U.S. for 64.7% of the categories analysed. On average, the steel exports to the U.S. decline for 1.4 months. When it comes to the relative share of positive and negative statistically significant impulse response values, 63.9% of the statistically significant values are negative. Moreover, 61.9% of the statistically significant impulse response estimates are also negative.
For the categories analysed, the average relative variation in the steel export variable that can be attributed to volatility in the oil price variable is moderate (35.3%), high (14.7%), or very high (11.8%) for a significant majority of the categories analysed (61.8%) which is an indicator for the significant explanatory power of the oil price variable for the steel export variable. Thereby, the average share of volatility in the steel export variable that is due to variation in the oil price variable for all categories analysed is 15.4% (moderate).
Recapitulatory, there is evidence that Japanese steel exports to the U.S. are negatively impacted by an oil price shock. The results are in line with the findings for total Japanese steel exports to the U.S. in section 6.2.8.5. Moreover, the variance decomposition estimates provide evidence for the explanatory power oil prices can have for steel trade volumes.

Price Patterns

The following findings provide evidence for the hypothesis that oil price shocks have a stronger impact on low-value steel trade than on high-value steel trade:

- The relative share of steel product categories for which significant volumes of steel have been exported from Japan to the U.S. during the sample period is larger for high-value exports (100%) than for low-value exports (93.1%).
- The average decline of steel exports from Japan to the U.S. lasts longer for low-value exports (1.4 months) than for high-value exports (1 month).
- On average, the explanatory power of the oil price variable for the steel export variable is higher for low-value categories (15.6%) than for high-value categories (14.4%).

The following findings provide evidence against the hypothesis:

- While export volumes from Japan to the U.S. decline for 71.4% of the high-value categories, export volumes decline for only 63% of the low-value categories.
- The relative share of statistically significant impulse response estimates is higher for high-value categories (71.4%) than for low-value categories (55.6%).

The estimates provide mixed evidence so that no definite statement can be made with regard to possible price patterns. By tendency, the evidence found that supports the hypothesis of price patterns is somewhat stronger than the evidence contradicting the hypothesis.

6.4.8.3 South Korea

Table 6.46 VEC Analysis – South Korea

Product Category	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
1B	1	4.690	3.0	0.00
3	1	-1.513	5.5	0.17
4	1	13.778	27.5	0.00
6A	1	-48.602	4.1	0.07
6B	1	-6.949 *	11.5	0.00
	2	-0.791		
7	1	-0.727	26.2	0.00
8	1	0.508	7.2	0.00
	2	0.560		
	3	1.101		
	4	1.543 *		
	5	0.828		
	6	0.174		
	7	0.151		

VEC Analysis - South Korea (continued)				
Product Category	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
14	1	-15.664	4.9	0.00
14A	1	-29.573	9.3	0.00
16	1	-8.900	25.7	0.00
	2	-15.586 *		
18	1	-200.018	5.1	0.00
	2	-71.296		
19	1	-80.188	17.9	0.00
	2	-137.238 *		
20	1	-11.148	10.3	0.46
21A	1	83.358 *	4.9	0.15
21B	1	-2.341	1.4	0.70
21CD	1	17.775	1.9	0.65
21E	1	-0.168	1.6	< 0.01
22A	1	-12.436	33.4	0.00
	2	-62.885		
22B	1	-36.947	1.1	0.69
	2	-2.982		
29	1	-15.435	3.3	< 0.1
	2	-53.683		
31	1	8.821	4.5	0.00
32	1	-126.495	1.5	0.25
	2	-381.743		
33A	1	-3.248	18.7	0.00
	2	-156.482 ***		
33B	1	-24.907	11.6	0.00
	2	-23.011		
34	1	-11.099	37.7	0.00
	2	-65.276		
35	1	-2.146	19.9	0.00
	2	-5.797		
36	1	-1.573	5.7	0.13
	2	-0.814		
37	1	-9.303	10.6	0.29
	2	-21.485 *		

Source:
Author's calculations (EViews®)

* statistically significant at 68% error bands
** statistically significant at 90% error bands
*** statistically significant at 95% error bands

1. Included and Excluded Steel Product Categories

The steel product category analysis for South Korea includes 28 of 36 categories. Eight categories have been excluded from the analysis for the following reasons:

- no exports to the U.S. during the sample period: 9
- exports to the U.S. during the sample period in less than ten months: 1a, 5, 15, 17, 23, 28, 29a

2. Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to decreasing steel exports from South Korea to the U.S. in 22 of the 28 steel product categories analysed (78.6%) and to increasing exports in the remaining 6 categories (21.4%).
The average immediate decline for the 28 categories lasts for 0.9 months. The average decline for the 22 categories with decreasing export volumes lasts for 1.6 months while the average increase for the 6 categories with increasing export volumes lasts for 2 months.
Seven of the 47 single impulse response values are statistically significant (relative share: 14.9%), 6 at 68% error bands and 1 at 95% error bands. Five of the 36 negative impulse response values (relative share: 13.9%) are statistically significant (68% error bands: 4; 95% error bands: 1), and 2 of the 11 positive impulse response values are statistically significant (16.7%). This means that 71.4% of the statistically significant impulse response values are negative.
The impulse response estimates for 7 of 28 categories (relative share: 25%) are (at least partially) statistically significant. When discriminating between categories with positive and negative impulse response estimates, 5 of 22 or 22.7% of the categories with negative estimates are statistically significant while 2 of 6 or 33.3% of the categories with positive estimates are also statistically significant. This means that 71.4% of the statistically significant impulse response estimates are negative.

3. Variance Decomposition Analysis

The average relative share of volatility in the steel export variable that is due to variation in the oil price variable is 11.3% (moderate) for all categories included, 12.1% (moderate) for the categories with negative impulse responses, and 8.2% (low) for the categories with positive impulse responses.
The average relative variation in the steel export variable that can be explained by variation in the oil price variable is very low for 11 of the 28 categories (39.3%), low for 5 categories (17.9%), moderate for 7 categories (25%), high for 3 categories (10.7%), and very high for 2 categories (7.1%).

Comparing the average relative importance of the explanatory variables to the volatility of the steel export variable (oil price: 11.3%; steel import value: 14.4%; exchange rates: 16.7%; U.S. real GDP: 6.9%) shows that the oil price variable has the third-largest explanatory power of all explanatory variables. To put it differently, the oil price variable explains most of the variation in the steel export variable relative to the other explanatory variables for 6 of 28 or 21.4% of the categories analysed.

4. Granger Causality Analysis

The GC test results confirm the statistical usefulness or the predictive value of the oil price variable for the steel export variable for 19 of 28 categories (1% level: 17; 10% level: 2), a relative share of 67.8%.

5. Price Pattern Analysis

During the sample period, South Korea exported significant volumes of steel to the U.S. in 23 of 29 low-value steel product categories (79.3%) and in 5 of 7 high-value categories (71.4%).

Following a one-standard deviation oil price shock, steel exports to the U.S. decrease in 18 of 23 low-value steel product categories (78.3%) and in 4 of 5 high-value categories (80%).

On average, exports in low-value steel product categories decrease for 0.8 months and for 1 month in high-value categories.

The impulse response estimates are statistically significant for 5 of 23 low-value steel product categories (21.7%) and for 2 of 5 high-value categories (40%).

The average relative volatility in the steel export variable that can be explained by variation in the oil price variable is 11.9% (moderate) for the low-value categories and 8.2% (low) for the high value categories.

6. Conclusion

Impulse Responses and Variance Decomposition

A one-standard deviation shock in the oil price variable leads to decreasing export volumes from South Korea to the U.S. for 78.6% of the categories analysed. On average, steel exports to the U.S. decline for 0.9 months. When it comes to the relative share of positive and negative statistically significant impulse response values, 71.4% of the statistically significant values are negative. Moreover, 71.4% of the statistically significant impulse response estimates are also negative.

For the categories analysed, the average relative variation in the steel export variable that can be attributed to volatility in the oil price variable is moderate (25%), high (10.7%), or very high (7.1%) for a strong minority of the categories analysed (42.8%) which serves as an indicator for the significant explanatory power of the oil price variable for the steel export variable. Thereby, the average share of volatility in the steel export variable that is due to variation in the oil price variable for all categories analysed is 11.3% (moderate).

Summing up, there is evidence that South Korean steel exports to the U.S. are negatively impacted by an oil price shock. The results are in line with the findings for total South Korean steel exports to the U.S. in section 6.2.8.9. Moreover, the variance decomposition estimates provide evidence for the explanatory power oil prices can have for steel trade volumes.

Price Patterns

The following findings provide evidence for the hypothesis that oil price shocks have a stronger impact on low-value steel trade than on high-value steel trade:

- On average, the explanatory power of the oil price variable for the steel export variable is higher for low-value categories (11.9%) than for high-value categories (8.2%).

The following findings provide evidence against the hypothesis:

- The relative share of steel product categories for which significant volumes of steel have been exported from South Korea to the U.S. during the sample period is larger for low-value exports (79.3%) than for high-value exports (71.4%).
- While export volumes from South Korea to the U.S. decline for 80% of the high-value categories, export volumes decline for only 78.3% of the low-value categories.
- The average decline of steel exports from South Korea to the U.S. lasts longer for high-value exports (1 month) than for low-value exports (0.8 months).
- The relative share of statistically significant impulse response estimates is higher for high-value categories (40%) than for low-value categories (21.7%).

The majority of the estimates contradict the hypothesis that low-value steel trade is impacted more by oil price shocks than high-value steel trade.

6.4.8.4 Taiwan

Table 6.47 VEC Analysis - Taiwan

Product Category	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
1A	1	-0.179	1.7	0.76
1B	1	2.032	17.7	0.00
3	1	-43.325 *	24.7	0.14
	2	-28.081		
	3	-57.267 *		
	4	-55.403 *		
	5	-85.486 ***		
	6	-67.075 *		
	7	-38.254		
	8	-18.260		
	9	-4.800		
4	1	-27.240	10.9	0.00
	2	-153.827 *		
	3	-70.188		
	4	-140.747		
	5	-359.724 **		
	6	-130.861		
	7	-64.169		
	8	-305.106 *		
	9	-150.953		
	10	-208.132		
	11	-182.148		
6A	1	25.869	6.0	0.71
	2	109.689 ***		
	3	79.759 *		
	4	61.438		
	5	49.653		
	6	27.539		
	7	2.808		
6B	1	-43.369	0.6	0.72
7	1	-0.014 *	7.6	0.00
	2	-0.013		
	3	-0.013 *		
	4	-0.004		
	5	-0.008		
	6	-0.003		
14	1	-2.609	10.1	0.00
	2	-15.862 *		

VEC Analysis - Taiwan (continued)				
Product Category	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
14A	1	1.505 **	5.7	0.44
	2	0.423		
	3	1.288 **		
	4	0.461		
16	1	-39.933 *	6.6	0.75
17	1	-0.309	2.2	0.00
18	1	-61.167 *	16.1	0.00
19	1	-0.097	17.1	0.00
	2	-0.098		
20	1	-22.304	22.6	0.38
21A	1	-0.968	9.5	0.00
	2	-2.256		
	3	-0.578		
	4	-4.405 *		
	5	-0.216		
21CD	1	-1.571	25.0	0.18
	2	-2.080		
	3	-21.012		
21E	1	-0.551 *	2.0	0.08
	2	-0.391		
	3	-0.092		
	4	-0.294		
	5	-0.038		
22A	1	0.267	2.4	0.00
	2	1.168		
	3	0.259		
	4	0.132		
23	1	-1.850	1.1	0.17
29	1	-33.098 *	4.4	0.18
31	1	95.559	5.2	0.00
	2	125.677		
	3	87.011		
	4	100.123		
32	1	-88.713	0.4	0.49
	2	-118.737		
	3	-108.873		

VEC Analysis - Taiwan (continued)				
Product Category	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
33A	1	-183.668 *	3.8	0.00
	2	-150.594		
	3	-48.363		
	4	-278.515 *		
	5	-180.511		
33B	1	26.801	2.4	0.27
34	1	71.296	5.3	0.05
36	1	-12.748 *	6.3	0.01
37	1	-2.444	12.8	0.01
	2	-7.605 *		

Source:
Author's calculations (EViews®)

* statistically significant at 68% error bands
** statistically significant at 90% error bands
*** statistically significant at 95% error bands

1. Included and Excluded Steel Product Categories

The steel product category analysis for Taiwan includes 27 of 36 categories. Nine categories have been excluded from the analysis for the following reasons:

- no exports to the U.S. during the sample period: 9, 22b, 35
- exports to the U.S. during the sample period in less than ten months: 5, 8, 15, 21b, 28, 29a

2. Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to decreasing steel exports from Taiwan to the U.S. in 20 of the 27 steel product categories analysed (74.1%) and to increasing exports in the remaining 7 categories (25.9%).

The average immediate decline for the 27 categories lasts for 1.5 months. The average decline for the 20 categories with decreasing export volumes lasts for 3.1 months and the average increase for the 7 categories with increasing export volumes also lasts for 3.1 months.

24 of the 84 single impulse response values are statistically significant (relative share: 28.6%), 19 at 68% error bands, 3 at 90% error bands, and 2 at 95% error bands. 20 of the 62 negative impulse response values (relative share: 32.6%) are statistically significant (68% error bands: 18; 90% error bands: 1; 95% error bands: 1), and 4 of the 22 positive impulse response values (relative share: 18.2%) are also statistically significant (68% error bands: 1;

90% error bands: 2; 95% error bands: 1). This means that 83.3% of the statistically significant impulse response values are negative.

The impulse response estimates for 14 of 27 categories (relative share: 51.9%) are (at least partially) statistically significant. When discriminating between categories with positive and negative impulse response estimates, 12 of 20 or 60% of the categories with negative estimates are statistically significant while 2 of 7 or 28.6% of the categories with positive estimates are also statistically significant. This means that 85.7% of the statistically significant impulse response estimates are negative.

3. Variance Decomposition Analysis

The average relative share of volatility in the steel export variable that is due to variation in the oil price variable is 8.5% (low) for all categories included, 9.3% (low) for the categories with negative impulse responses, and 6.4% (low) for the categories with positive impulse responses.

The average relative variation in the steel export variable that can be explained by variation in the oil price variable is very low for 10 of the 27 categories (37%), low for 8 categories (29.6%), moderate for 6 categories (22.2%), high for 3 categories (11.1%), and very high for none of the categories.

Comparing the average relative importance of the explanatory variables to the volatility of the steel export variable (oil price: 8.5%; steel import value: 12%; exchange rates: 8.8%; U.S. real GDP: 6.6%) shows that the oil price variable has the third-largest explanatory power of all explanatory variables. To put it differently, the oil price variable explains most of the variation in the steel export variable relative to the other explanatory variables for 4 of 27 or 14.8% of the categories analysed.

4. Granger Causality Analysis

The GC test results confirm the statistical usefulness or the predictive value of the oil price variable for the steel export variable for 15 of 27 categories (1% level: 11; 5% level: 2; 10% level: 2), a relative share of 55.6%.

5. Price Pattern Analysis

During the sample period, Taiwan exported significant volumes of steel to the U.S. in 21 of 29 low-value steel product categories (72.4%) and in 6 of 7 high-value categories (85.7%).

Following a one-standard deviation oil price shock, steel exports to the U.S. decrease in 14 of 21 low-value steel product categories (66.7%) and in 6 of 6 high-value categories (100%).

On average, exports in low-value steel product categories decrease for 1.3 months and exports in high-value categories decline for 2.3 months.

The impulse response estimates are statistically significant for 11 of 21 low-value steel product categories (52.3%) and for 3 of 6 high-value categories (50%)

The average relative volatility in the steel export variable that can be explained by variation in the oil price variable is 8.5% (low) for the low-value categories and 8.4% (low) for the high-value categories.

6. Conclusion

Impulse Responses and Variance Decomposition

A one-standard deviation shock in the oil price variable leads to decreasing export volumes from Taiwan to the U.S. for 74.1% of the categories analysed. On average, the steel exports to the U.S. decline for 1.5 months. When it comes to the relative share of positive and negative statistically significant impulse response values, 83.3% of the statistically significant values are negative. Moreover, 85.7% of the statistically significant impulse response estimates are also negative.

For the categories analysed, the average relative variation in the steel export variable that can be attributed to volatility in the oil price variable is moderate (22.2%), high (11.1%), or very high (0%) for a minority of the categories analysed (33.3%). Thereby, the average share of volatility in the steel export variable that is due to variation in the oil price variable for all categories analysed is 8.5% (low).

Summing up, there is evidence that Taiwanese steel exports to the U.S. are negatively impacted by an oil price shock. The results are in line with the findings for total Taiwanese steel exports to the U.S. in section 6.2.8.10. The explanatory power of the oil price variable for the steel export variable, however, is significantly lower when compared to the explanatory power of the oil price variable for most of the other countries analysed.

Price Patterns

The following findings provide evidence for the hypothesis that oil price shocks have a stronger impact on low-value steel trade than on high-value steel trade:

- The relative share of steel product categories for which significant volumes of steel have been exported from Taiwan to the U.S. during the sample period is larger for high-value exports (85.7%) than for low-value exports (72.4%).
- The relative share of statistically significant impulse response estimates is higher for low-value categories (52.3%) than for high-value categories (50%).
- On average, the explanatory power of the oil price variable for the steel export variable is higher for low-value categories (8.5%) than for high-value categories (8.4%).

The following findings provide evidence against the hypothesis:

- While export volumes from Taiwan to the U.S. decline for 100% of the high-value categories, export volumes decline for only 66.7% of the low-value categories.
- The average decline of steel exports from Taiwan to the U.S. lasts longer for high-value exports (2.3 months) than for low-value exports (1.3 months).

The estimates provide mixed evidence. Therefore, no definite statement can be made with regard to possible price patterns. By tendency, the evidence found that supports the hypothesis of price patterns is somewhat stronger than the evidence contradicting the hypothesis.

6.4.9 Oceania (Australia)

For Oceania, Australia has been selected for the analysis of steel exports to the U.S. by steel product category.

Table 6.48 VEC Analysis - Australia

Product Category	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
1A	1	-1.292	2.2	0.60
	2	-1.077		
1B	1	-1,980.946	12.8	0.73
	2	-3,915.251 *		
	3	-4,039.481 *		
	4	-989.651		
	5	-3,067.655		
	6	-3,054.337		
	7	-1,075.151		
	8	-1,076.445		
	9	-2,484.631		
	10	-4,404.834 *		
	11	-2,671.549		
4	1	1.184	1.3	0.00
	2	0.110		
	3	1.339		
	4	1.219		
6A	1	-365.297 *	1.8	0.13
	2	-101.724		
6B	1	258.630 **	4.8	0.07
	2	257.196 *		

VEC Analysis - Australia (continued)				
Product Category	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
9	1	-36.898 *	20.0	0.78
	2	-3.892		
	3	-24.613		
14	1	-0.228	42.8	0.45
	2	-1.081 *		
	3	-0.654		
15	1	-8.127	1.0	0.79
	2	-16.269 *		
	3	-8.282		
	4	-6.341		
	5	-0.083		
	6	-5.359		
	7	-4.828		
16	1	23.211 *	4.3	0.21
17	1	5.685	2.5	0.70
18	1	-0.664	3.2	< 0.01
19	1	-3.595 *	5.9	0.87
	2	-4.851 *		
	3	-4.089 *		
	4	-2.861		
	5	-3.136		
21A	1	-8.607 *	26.9	0.05
	2	-6.766		
	3	-10.588 *		
21CD	1	-0.446	19.7	0.24
	2	-0.765 *		
	3	-0.413		
21E	1	0.219	0.6	0.16
22A	1	3.305	6.0	0.91
23	1	-14.565 *	16.6	< 0.01
	2	-1.242		
	3	-13.002 *		
28	1	185.793 *	10.4	0.00
	2	91.121		
29	1	-15.855 *	57.9	0.00
29A	1	-0.496 *	17.4	0.00
31	1	-2,231.790 *	11.2	0.23

VEC Analysis - Australia (continued)				
Product Category	Time Period (months)	Impulse Responses (to 1 s.d.shock, in qmt)	Variance Decomposition (after 15 months, in %)	Granger Causality (p-value)
32	1	-352.949 *	45.9	0.00
	2	-749.150 ***		
	3	-1,068.786 ***		
	4	-142.979		
34	1	-7.410 ***	5.0	0.73
	2	-9.185 ***		
36	1	-12.363 **	11.4	< 0.01
	2	-2.957		
37	1	7.387	13.5	0.79
	2	13.058 *		
	3	7.254		
	4	7.580		
	5	6.950		
	6	8.867		

Source:
Author's calculations (EViews®)

* statistically significant at 68% error bands
** statistically significant at 90% error bands
*** statistically significant at 95% error bands

1. Included and Excluded Steel Product Categories

The steel product category analysis for Australia includes 25 of 36 categories. 11 categories have been excluded from the analysis for the following reasons:

- no exports to the U.S. during the sample period: 21b
- exports to the U.S. during the sample period in less than ten months: 3, 5, 7, 8, 14a, 20, 22b, 33b, 35
- category sample includes one or more I(2) variables: 33a

2. Impulse Response Analysis

A one-standard deviation shock to the real oil price leads to decreasing steel exports from Australia to the U.S. in 17 of the 25 steel product categories analysed (68%) and to increasing exports in 8 categories (32%).

The average immediate decline for the 25 categories lasts for 1.4 months. The average decline for the 17 categories with decreasing export volumes lasts for 3.2 months while the average increase for the 8 categories with increasing export volumes lasts for 2.3 months.

29 of the 72 single impulse response values are statistically significant (relative share: 40.3%), 23 at 68% error bands, 2 at 90% error bands, and 4 at 95% error bands. 24 of the 54

negative impulse response values (relative share: 44.4%) are statistically significant (68% error bands: 19; 90% error bands: 1; 95% error bands: 4) and 5 of the 18 positive impulse response values (relative share: 27.8%) are also statistically significant (68% error bands: 4; 90% error bands: 1). This means that 82.8% of the statistically significant impulse response values are negative.

The impulse response estimates for 19 of 25 categories (relative share: 76%) are (at least partially) statistically significant. When discriminating between categories with positive and negative impulse response estimates, 15 of 17 or 88.2% of the categories with negative estimates are statistically significant while 4 of 8 or 50% of the categories with positive estimates are also statistically significant. This means that 78.9% of the statistically significant impulse response estimates are negative.

3. Variance Decomposition Analysis

The average relative share of volatility in the steel export variable that is due to variation in the oil price variable is 13.8% (moderate) for all categories included, 17.7% (moderate) for the categories with negative impulse responses, and 5.4% (low) for the categories with positive impulse responses.

The average relative variation in the steel export variable that can be explained by variation in the oil price variable is very low for 10 of the 25 categories (40%), low for 2 categories (8%), moderate for 9 categories (36%), high for 1 category (4%), and very high for 3 categories (12%).

Comparing the average relative importance of the explanatory variables to the volatility of the steel export variable (oil price: 13.8%; steel import value: 10.8%; exchange rates: 5.7%; U.S. real GDP: 7.3%) shows that the oil price variable has the largest explanatory power of all explanatory variables. To put it differently, the oil price variable explains most of the variation in the steel export variable relative to the other explanatory variables for 10 of 25 or 40% of the categories analysed.

4. Granger Causality Analysis

The GC test results confirm the statistical usefulness or the predictive value of the oil price variable for the steel export variable for 10 of 25 categories (1% level: 8; 10% level: 2), a relative share of 40%.

5. Price Pattern Analysis

During the sample period, Australia exported significant volumes of steel to the U.S. in 19 of 29 low-value steel product categories (65.5%) and in 6 of 7 high-value categories (85.7%).

Following a one-standard deviation oil price shock, steel exports to the U.S. decrease in 15 of 19 low-value steel product categories (79%) and in 2 of 6 high-value categories (33.3%).
On average, exports in low-value steel product categories decrease for 2.3 months and exports in high-value categories decline for 0.7 months.
The impulse response estimates are statistically significant for 16 of 19 low-value steel product categories (84.2%) and for 3 of 6 high-value categories (50%).
The average relative volatility in the steel export variable that can be explained by variation in the oil price variable is 15.9% (moderate) for the low-value categories and 7.1% (low) for the high-value categories.

6. Conclusion

Impulse Responses and Variance Decomposition

A one-standard deviation shock in the oil price variable leads to decreasing export volumes from Australia to the U.S. for 68% of the categories analysed. On average, the steel exports to the U.S. decline for 1.4 months. When it comes to the relative share of positive and negative statistically significant impulse response values, 82.8% of the statistically significant values are negative. Moreover, 78.9% of the statistically significant impulse response estimates are also negative.
For the categories analysed, the average relative variation in the steel export variable that can be attributed to volatility in the oil price variable is moderate (36%), high (4%), or very high (12%) for the majority of the categories analysed (52%). Thereby, the average share of volatility in the steel export variable that is due to variation in the oil price variable for all categories analysed is 13.8% (moderate).
Summing up, there is evidence that Australian steel exports to the U.S. are negatively impacted by an oil price shock. The results are in line with the findings for total Australian steel exports to the U.S. in section 6.2.9.1. Moreover, the variance decomposition estimates provide evidence for the explanatory power oil prices can have for steel trade volumes.

Price Patterns

The following findings provide evidence for the hypothesis that oil price shocks have a stronger impact on low-value steel trade than on high-value steel trade:

- The relative share of steel product categories for which significant volumes of steel have been exported from Australia to the U.S. during the sample period is larger for high-value exports (85.7%) than for low-value exports (65.5%).
- While export volumes from Australia to the U.S. decline for 79% of the low-value categories, export volumes decline for only 33.3% of the high-value categories.

- The average decline of steel exports from Australia to the U.S. lasts longer for low-value exports (2.3 months) than for high-value exports (0.7 months).
- The relative share of statistically significant impulse response estimates is higher for low-value categories (84.2%) than for high-value categories (50%).
- On average, the explanatory power of the oil price variable for the steel export variable is higher for low-value categories (15.9%) than for high-value categories (7.1%).

The estimates support the hypothesis that low-value steel trade is impacted more by oil price shocks than high-value steel trade.

6.4.10 Summary

Impulse Responses and Variance Decomposition

In addition to the analysis in sections 6.2 (steel exports by country) and 6.3 (steel exports by region), the analysis in section 6.4 (steel exports by category) provides further evidence that an oil price shock leads to decreasing export volumes to the U.S. for geographically distant countries and to increasing export volumes for geographically close countries.

Following a one-standard deviation oil price shock, steel exports decrease for a majority of the steel product categories analysed for the countries from Europe (Belgium, France, Germany, Italy, Netherlands, Spain), the C.I.S. (Russia, Ukraine), Africa (South Africa), the Middle East (Turkey), Asia (China, Japan, South Korea, Taiwan), and Oceania (Australia).

As can be seen in table 6.49 for the above-mentioned countries the relative share of categories with negative impulse response estimates is between 64.7% (Japan) and 90% (South Africa) [column 1], the average decline of steel imports to the U.S. lasts for a time period between 0.9 months (South Korea, Ukraine) and 3.3 months (Italy) [column 2], the relative share of negative statistically significant single impulse response values is between 63.9% (Japan) and 100% (China, Russia, Turkey, Ukraine) [column 3], the relative share of negative statistically significant impulse response estimates is between 61.9% (Japan) and 100% (China, Russia, Turkey, Ukraine) [column 4], the relative share of categories analysed for which the explanatory power of the oil price variable for the steel export variable is moderate, high, or very high is between 33.3% (Taiwan) and 65.3% (Netherlands) [column 5], and the average relative importance of the oil price variable for the steel export variable is between 8.5% (Taiwan) and 18.7% (Italy) [column 6].

Table 6.49 Statistical Analysis of Impulse Response and Variance Decomposition Estimates

Region / Country	Categories with Decreasing Export Volumes (in %)	Average Decrease of Steel Exports to the U.S. (in months)	Statistically Significant Negative IR Values (in %)	Statistically Significant Negative IR Estimates (in %)	Moderate, High, Very High VD Estimates (in %)	Average Explanatory Power of Oil Price Variable (in %)
Europe						
Belgium	78.1	1.8	82.6	76.5	46.9	13.2
France	69.0	1.3	80.0	73.3	55.1	13.0
Germany	82.9	2.3	95.5	92.3	51.5	13.8
Italy	85.7	3.3	93.1	86.7	60.7	18.7
Netherlands	80.8	1.0	93.8	90.0	65.3	16.4
Spain	77.8	2.0	95.6	92.3	55.5	14.1
C.I.S.						
Russia	89.5	3.1	100.0	100.0	47.4	13.4
Ukraine	80.0	0.9	100.0	100.0	53.4	9.5
Africa						
South Africa	90.0	1.6	85.7	83.3	45.0	11.9
Middle East						
Turkey	72.3	1.9	100.0	100.0	54.6	14.3
Asia						
China	87.5	2.5	100.0	100.0	50.0	13.9
Japan	64.7	1.4	63.9	61.9	61.8	11.3
South Korea	78.6	0.9	71.4	71.4	42.8	11.3
Taiwan	74.1	1.5	83.3	85.7	33.3	8.5
Oceania						
Australia	68.0	1.4	82.8	78.9	52.0	13.8

Source: Author's calculations

At the same time, steel exports from North- (Canada, Mexico) and South America (Brazil) to the U.S. increase for a significant majority of the steel product categories analysed.

Table 6.50 Statistical Analysis of Impulse Response and Variance Decomposition Estimates

Region / Country	Categories with Increasing Export Volumes (in %)	Average Increase of Steel Exports to the U.S. (in months)	Statistically Significant Positive IR Values (in %)	Statistically Significant Positive IR Estimates (in %)	Moderate, High, Very High VD Estimates (in %)	Average Explanatory Power of Oil Price Variable (in %)
North America						
Canada	86.6	3.3	98.1	94.7	57.2	16.0
Mexico	75.0	2.2	76.0	76.2	68.8	16.9
South America						
Brazil	71.0	1.4	77.4	68.4	58.1	12.3

Source: Author's calculations

As can be seen in table 6.50 the relative share of categories with positive impulse response estimates for the three above-mentioned countries is between 71% (Brazil) and 86.6% (Canada) [column 1], the average increase of steel imports to the U.S. lasts for a time period between 1.4 months (Brazil) and 3.3 months (Canada) [column 2], the relative share of positive statistically significant single impulse response values is between 77.4% (Brazil) and 98.1% (Canada) [column 3], the relative share of positive statistically significant impulse response estimates is between 68.4% (Brazil) and 94.7% (Canada) [column 4], the relative share of categories analysed for which the explanatory power of the oil price variable for the steel export variable is moderate, high, or very high is between 57.2% (Canada) and 68.8% (Mexico) [column 5], and the average relative importance of the oil price variable for the steel export variable is between 12.3% (Brazil) and 16.9% (Mexico) [column 6].

Finally, table 6.51 shows that on average, the oil price variable explains the largest share of variation in the steel export variable of all explanatory variables for 12 of 18 countries, the second-largest share for 4 countries (Russia, Ukraine, Brazil, China), and the third-largest share for 2 countries (South Korea, Taiwan).

Table 6.51 Average Explanatory Power of the Explanatory Variables (in%)

	OIL	VALUE	EXRA	RGDP
Europe				
Belgium	13.2	9.0	6.9	7.0
France	13.0	9.1	6.7	7.0
Germany	13.8	8.8	6.6	7.2
Italy	18.7	13.5	7.0	7.2
Netherlands	16.4	10.9	5.9	5.8
Spain	14.1	12.7	5.8	6.4
C.I.S.				
Russia	13.4	16.7	10.5	6.0
Ukraine	10.8	12.1	7.7	7.7
North America				
Canada	16.0	12.3	9.6	7.4
Mexico	16.9	12.7	7.2	6.2
South America				
Brazil	12.3	14.1	6.4	7.9
Africa				
South Africa	11.9	9.8	7.2	6.2
Middle East				
Turkey	14.3	13.7	7.8	6.5
Asia				
China	13.9	16.0	10.4	4.7
Japan	15.4	13.2	9.8	6.5
South Korea	11.3	14.4	16.7	6.9
Taiwan	8.5	12.0	8.8	6.6
Oceania				
Australia	13.8	10.8	5.7	7.3

Source: Author's calculations

Moreover, table 6.52 shows that for 12 of 18 countries, the oil price variable explains most of the variation in the steel export variable for a significant minority or the majority of the categories (= rank 1).

Table 6.52 Ranks of the Oil Price Variable

	Rank 1		Rank 2		Rank 3		Rank 4	
	abs.	in %	abs.	in %	abs.	in %	abs.	in %
Europe								
Belgium	14	43.8	9	28.1	7	21.9	2	6.3
France	15	51.7	6	20.7	4	13.8	4	13.8
Germany	14	40.0	12	34.3	7	20.0	2	5.7
Italy	14	50.0	6	21.4	5	17.9	3	10.7
Netherlands	13	50.0	9	34.6	3	11.5	1	3.8
Spain	11	40.7	11	40.7	3	11.1	2	7.4
C.I.S.								
Russia	6	31.6	8	42.1	4	21.1	1	5.3
Ukraine	3	20.0	7	46.7	3	20.0	2	13.3
North America								
Canada	12	34.3	8	22.9	11	31.4	4	11.4
Mexico	18	56.3	9	28.1	4	12.5	1	3.1
South America								
Brazil	11	35.5	11	35.5	7	22.6	2	6.4
Africa								
South Africa	10	50.0	3	15.0	5	25.0	2	10.0
Middle East								
Turkey	9	40.9	9	40.9	3	13.6	1	4.5
Asia								
China	10	31.3	11	34.4	8	25.0	3	9.4
Japan	15	44.1	8	23.5	8	23.5	3	8.8
South Korea	6	21.4	7	25.0	9	32.1	6	21.4
Taiwan	4	14.8	7	26.0	8	29.6	8	29.6
Oceania								
Australia	10	40.0	6	24.0	5	20.0	4	16.0
Total	195	39.2	147	29.6	104	20.9	51	10.3

Source: Author's calculations

Although the average of the impulse response and variance decomposition estimates by category cannot be compared directly with the estimates for aggregated steel exports by country (for example, some categories with large export volumes may impact the estimates for the total exports by country overproportionally), the trends in the analysis per category are by tendency in line with the estimates of the analysis by country for all countries included in the analysis by category (see 6.2).

Price Patterns

In addition to the analysis of the impulse response and variance decomposition estimates by category, the analysis in section 6.4 also focuses on the question whether low-value steel exports to the U.S. are overproportionally affected by rising oil prices/transport costs when compared with high-value steel exports due to the higher share of transport costs to final selling prices. In this context, a set of evaluation criteria is applied in the price pattern section in the above analysis. The results of the analysis are summarised in table 6.53.

Table 6.53 Evaluation Criteria for Price Pattern Analysis

Region / Country	Higher Relative Share of Significant Export Volumes in Low-Value Categories	Higher Relative Share of Increasing, Decreasing Exports in Low-Value Categories	Longer Average Decline/Increase of Exports in Low-Value Categories	Higher Relative Share of Statstically Significant IR-Estimates in Low-Value Categories	Higher Average Explanatory Power of Oil Prices for Low-Value Categories	Supports/Contradiction of Hypotheses
Europe						
Belgium	+	-	+	+	+	+
France	+	+	-	+	+	+
Germany	+	-	-	-	-	-
Italy	+	+	-	-	+	mixed evidence, tendency: +
Netherlands	+	-	-	-	+	mixed evidence, tendency: -
Spain	+	-	-	-	-	-
C.I.S.						
Russia	-	-	+	-	-	-
Ukraine	+	-	-	+	-	mixed evidence, tendency: -
North America						
Canada	+	+	+	+	+	+
Mexico	+	+	+	+	-	+
South America						
Brazil	+	-	+	+	-	mixed evidence, tendency: +
Africa						
South Africa	+	-	+	+	-	mixed evidence, tendency: +
Middle East						
Turkey	+	+	+	+	+	+
Asia						
China	+	+	+	+	-	+
Japan	+	-	+	-	+	mixed evidence, tendency: +
South Korea	-	-	-	-	+	-
Taiwan	+	-	-	+	+	mixed evidence, tendency: +
Oceania						
Australia	+	+	+	+	+	+
Total	+: 16, -: 2	+: 7, -: 11	+: 10, -: 8	+: 11, -: 7	+: 10, -: 8	+: 7, -: 4, mixed: 5+, 2-

Hypothesis accepted: + Hypothesis rejected: -

Source: Author's evaluation

For the steel industries of 16 of the 18 countries (88.9%) included in the analysis, the relative share of high-value steel product categories where significant volumes of steel are exported to the U.S. is larger than the relative share of high-value categories [see column 1]. Of course, total volumes of high- and low-value steel exports also need to be taken into consideration. However, the relative share of categories with significant export volumes still may be an indicator that high-value steel exports to the U.S. during the sample period may have been relatively more attractive than low-value exports, especially for geographically distant countries.

The relative share of categories where steel exports to the U.S. decrease following an oil price shock is larger for the low-value group than for the high-value group for 5 of 15 countries whose steel industries are negatively affected. Moreover, the relative share of categories where steel exports increase following an oil price shock is larger for the low-value group than for the high-value group in 2 of 3 countries (Brazil, Canada, Mexico) whose steel industries are positively affected. In other words, low-value steel exports to the U.S. are overproportionally affected relative to high-value steel exports in 7 of 18 countries (38.9%) [see column 2].

The average decline of steel exports to the U.S. lasts longer for the low-value group than for the high-value group for 7 of 15 countries whose steel industries are negatively affected by the shock in the oil price variable. Moreover, the average increase of steel exports to the U.S. lasts longer for the low-value group than for the high-value group for the 3 countries whose steel industries are positively affected by the shock in the oil price variable. In total, in 10 of 18 cases (55.6%) the effect caused by the oil price shock lasts longer for low-value steel exports [see column 3].

The relative share of statistically significant impulse response estimates is larger for low-value categories than for high-value categories for 11 of 18 countries analysed (61.1%) [see column 4]. This may indicate that the impact of the shock in the oil price variable on low-value steel exports is more pronounced than the impact of the shock in the oil price variable on high-value steel exports.

The explanatory power of the oil price variable for the steel export variables of low-value steel exports is larger than for high-value steel exports for the steel exports of 10 of 18 countries analysed (55.6%) [see column 5]. The fact that the explanatory power of the oil price variable is stronger in the context of low-value steel exports to the U.S. for a majority of the countries analysed indicates that low-value exports are overproportionally affected by rising oil prices when compared to high-value exports.

Summing up, the majority of the estimates indicate that low-value steel exports to the U.S. are overproportionally affected by oil price shocks for 4 of 5 evaluation criteria.

For 7 of 18 countries, a significant majority or all evaluation criteria estimates support the hypothesis that low-value steel exports to the U.S. are over-proportionally affected by oil price shocks. For 4 of 18 countries, a significant majority or all evaluation criteria estimates provide evidence against the hypothesis. The evidence for the remaining 7 countries is mixed so that no clear tendency can be identified. However, in 5 of 7 cases, the evidence found that supports the hypothesis of price patterns is somewhat stronger than the evidence contradicting the hypothesis. Therefore, there is clear evidence for price patterns for 7 of 18 countries (38.9%) and a tendency that supports the assumption of price patterns exists in 5 of 18 cases (27.8%). On the other hand, there is clear evidence against price patterns in 4 of 18 cases (22.2%) and a tendency that against the assumption of price patterns in 2 of 18 cases (11.1%) [see column 6].

Recapitulatory, although the analysis of the evidence in the price pattern sections provides mixed evidence and the evaluation criteria provide only a first insight into possible price patterns, the majority of the estimates (66.7%) rather indicate that low-value steel exports to the U.S. are more affected by rising oil prices than high-value steel exports due to the higher share of transport costs to final selling prices and therefore indicate the existence of price patterns.

6.5 Conclusion

Sections 6.2 to 6.4 analyse the impact of a one-standard deviation oil price shock on steel export volumes to the U.S. of geographically close and distant countries (total exports and exports by category) and regions. At large, the analyses of the impulse response estimates from a national (see section 6.2, 6.4) and a regional perspective (see 6.3) show an adverse effect of the oil price shock on the export volumes of steel industries from geographically distant countries/regions and a positive effect on the export volumes of steel industries in countries/regions geographically close to the United States. Although the one-standard deviation oil price shock is only an approximation to reality (For instance, there is usually a time lag between the occurrence of an oil price shock and its economic impact for several reasons such as existing supply contracts. Research suggests that usually, the bulk of impacts are felt four quarters after the initial oil price increase (Donovan et al. 2008).), the analysis provides valuable insights into the impact of oil price shocks on trade volumes and trade patterns of a key industry. Moreover, the majority of the variance decomposition estimates indicate the significant explanatory power of the oil price variable for the steel export variable. Finally, there is initial evidence for the existence of price patterns for steel exports to the United States. The findings are in line with economic theory about the role of distance and prices in international trade.

7 Analysis III: The Future Shape of the World Economy – Globalisation and/or Regionalisation?

Given the findings of the econometric analysis, the following questions come to mind: Can the findings in chapter 6 be generalised? Will the process of globalisation towards economic globalism continue? Will the process be reversed into a de-globalisation process towards regionalisation? Or will some industries remain globalised while others become increasingly regionalised? What are the prospects for the shape of the future global economy?

In order to address these questions, chapter 7 puts the findings of the econometric analysis into a wider context by describing the forces behind trade globalisation and by analysing how peak oil or rising oil prices affect trade globalisation through the transport cost channel. Thereby, the focus is on vertical specialisation, the composition of world trade and international commodity price convergence/dispersion. Moreover, the relationship between economic globalisation and regionalisation and the lessons that can be learned from the history of globalisation are also described.

In this context, section 7.1 analyses the interdependencies between international transport costs, vertical specialisation and trade globalisation. Section 7.2 then describes the relationship between international transport costs, the composition of world trade and trade globalisation. Section 7.3 focuses on the link between international transport costs, commodity price convergence/dispersion and trade globalisation. Section 7.4 analyses the relationship between economic globalisation and regionalisation. Finally, section 7.5 links the findings in chapter 6 with the history of economic globalisation and section 7.6 concludes.

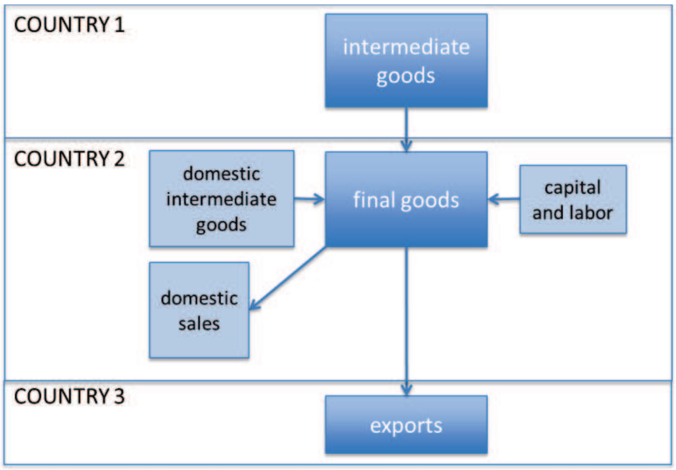
7.1 The Link between International Transport Costs, Vertical Specialisation and Trade Globalisation

There are three preconditions for vertical specialisation[89] to take place (see figure 7.1):

1. Goods are produced in multiple, sequential stages.
2. Two or more countries provide value added in the production sequence of the good.
3. At least one country uses imported goods in its stage of the production process, and some of the output needs to be exported (Yi 2003)[90].

Vertical specialisation involves the growing interconnectedness of production within a sequential vertical trading chain that stretches across multiple countries. Thereby, some industries in the respective countries are specialised in particular stages of the production process.

Figure 7.1 Vertical Specialisation



Author's illustration, see Yi 2003

For example, prior to vertical specialisation taking shape, U.S. steel was used in U.S. farm equipment production, with some of the equipment exported to other countries. In an increasingly globalised world, however, Japanese or Chinese steel is exported to Mexico where it is stamped and pressed. Finally, the processed steel is exported to the U.S. where it is used for farm equipment manufacturing. Some of the equipment is then sold in the domestic market while the rest is exported to other countries. As a result, the amount of trade and transport involved in producing a tractor and getting it to its final destination has grown substantially (Yi 2003).

As indicated in the above example, production sharing among countries leads to an increase of international trade volumes (Dean et al. 2007; Hummels 2009; Krugman 1995) due to a multiplier effect[91] (Bourguignon et al. 2002; UNCTAD 2009). Recent empirical research shows that vertical specialisation has contributed about 30% to total trade growth between 1970 and 2000 (Hummels et al. 1998, 2001; Yi 2003). In the late 1990s, already 30% of international trade in manufactures could be attributed to trade in intermediate products with tendency to rise (Bird and Rajan 2001; Bourguignon et al. 2002; Yeats 1998).

The multiplier effect also leads to a multiplication of transport costs (Gangnes et al. 2011a) and increasing demand for maritime transport (Hesse and Rodrigue 2004). As trade in merchandise and intermediate products grows, so does demand for ocean transport services which are an integral part of the global logistics chain (Kumar and Hoffmann 2002: 58).

Thereby, the distance of trade and ton-mile trade figures[92] also increase because vast quantities of raw materials, semi-finished and finished goods need to be transported over long distances within global production networks (MacKinnon et al. 2008: 17). Hence, one major reason for the growth of long-distance trade is that different stages of production processes for commodities are now performed at several (often widely scattered) locations around the globe (Scholte 2008). This trend goes hand in hand with increasing time sensitivity in world trade (MacKinnon et al.: 17; UNCTAD 2009).

Vertical specialisation is based on comparative advantage (Dicken 1998; Hesse and Rodrigue 2004; Hummels 2007b; Hummels et al. 2001) which is exploited within the vertical chain of a good's production (Bourguignon et al. 2002). Comparative advantages are usually based on cheap labour, the supply of low-cost natural resources, or geographical location[93] (Guerrero de Lizardi and Padilla-Pérez 2010). Thereby, differences in labour costs use to be *the* most important factor[94] (Hesse and Rodrigue 2004; Wilsmeier and Martinez-Zarzoso 2010). The vertical disintegration of production has developed mainly, though not exclusively, through the location of labour intensive stages in the production process at low-wage manufacturing platforms[95] (Scholte 2005: 107) from where semi-finished products are shipped to yet other locations for further work (Krugman 1995).

Due to the large share of imported inputs, the export value of goods produced by industries with a significant extent of vertical specialisation is often substantially larger than the value added (Krugman 1995). As Krugman (1995: 336) puts it, "because of the growing vertical disintegration of industry the value added by a given manufacturing facility is likely to be only a small fraction of the value of its shipments; and thus the labor share of that value added is also a small fraction of costs, which are dominated by the cost of intermediate inputs."[96]

For exports including only a small share of value added, however, the penalty of higher transport costs is especially burdensome (Limao and Venables 2001; Ma and Van Assche 2010; Radelet and Sachs 1998). The reason for this is that the share of transport costs in the final value of the good increases because the value of the final good not only includes the transportation costs from its origin to its destination (downstream transport costs), but also the transportation costs for all the components or raw materials which have been purchased internationally (upstream transport costs) (Kumar and Hoffmann 2002: 43).

Therefore, the trade of commodities with a high share of value added by the import of intermediate goods significantly depends on low transport costs. More precisely, this kind of commodity trade is the *result* of low transport costs (Lundgren 1996).

Prior to the dramatic increase of oil prices and the resulting high international transport costs during 2007/2008, many economists regarded transport costs as a component of minor importance for international trade[97]. Behar and Venables (2010: 16), however, note that the benefits of improved transport technology, reduced journey time and comparatively low transport costs have important implications for the composition of international trade, thereby enabling previously untradeable goods to be traded and production processes to be fragmented. Stopford (2009: 63) also emphasises that the transport cost variable is essential for international trade as the business philosophy of internationally fractured manufacturing depends on cheap transport. Therefore, transportation costs must be treated as an integral part of the dispersed production process (Pedersen 2001: 86).

Hence, what happens to vertical specialisation based globalisation in case of a persistent increase of transport costs? As a result of the multiplier-effect, global production networks based on vertical specialisation are more sensitive to rising transport costs than regular trade (Yi 2003; Ma and Van Assche 2010). In many labour-intensive manufacture export industries, export profit margins are rather thin and the share of imported inputs constitutes a large proportion of total output value. In those industries, even moderate changes in shipping costs can make a difference between profitability and loss in exports (Radelet and Sachs 1998). At the height of the oil price crisis in 2008, experts acknowledged that rising fuel costs were threatening to outweigh labour savings achieved by vertical specialisation (Murphy 2008).[98]

Generally, in competitive worldwide markets significantly rising transportation costs have to be compensated either by wage cost reductions or cost reductions somewhere else in the production process to enable firms to remain competitive. High ad valorem transportation costs matter less for high-value products than for low-value products. In case high transport cost levels foster regionalisation, low-value manufactured products such as clothing, textiles, plastic toys or steel are likely to be more affected than high-value products (UNCTAD 2008).

7.2 The Link between International Transport Costs, the Composition of World Trade and Trade Globalisation

Transport costs are an important factor for the composition of international trade (Behar and Venables 2010: 1; Sampson and Yeats 1977). Between the mid-1980s and the late 1990s, declining transport costs shaped the geography of world trade. As a consequence, previously non-tradable commodities became tradable (Behar and Venables 2010: 16; Rodrigue 2009) and the substitutability between domestic and foreign goods increased (Ravn and Mazzenga 2004). This resulted in growing international trade with competing goods contrary to previous decades when international trade mainly consisted of non-competing goods (O'Rourke and Williamson 2002).

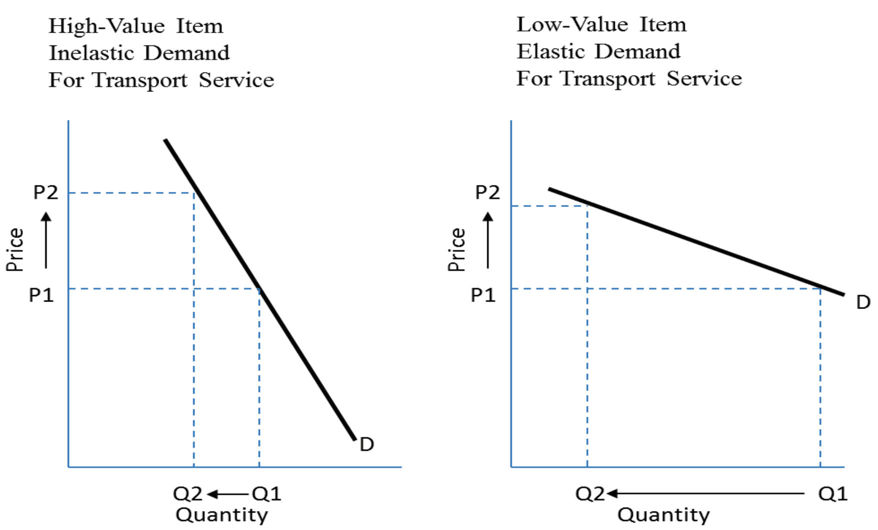
Shrinking transport costs in all transportation modes and growing transport mode availability (especially air transport) also led to an increase in the speed of transport (Hummels 1999b). Increasing long-distance trade of non-traditional agricultural exports like fresh vegetables or cut flowers from geographical remote regions (e.g. Sub-Saharan Africa) are the most obvious examples for increasing transport speed and growing mobility of goods (Behar and Venables 2010: 16; Bordo et al. 1999; Hummels 1999b; 2007a; b; Keohane and Nye 2000).

Between 2000 and 2008, however, rapidly increasing transport costs put the sustainability of such trade into doubt because high cost levels led to a slowdown in the global mobility of goods. Kousnetzoff et al. (2008) find that the 7.5 fold increase of oil prices between 1998 and 2008 resulted in an average growth of 6.1% in the relative cost of air transport compared to ocean transport. As a consequence, the proportion of goods transported by air decreased by 12.3% for the benefit of ocean transport. Simultaneously, ocean transport speed also declined due to rising fuel costs. The substitution effect found by Kousnetzoff et al. is also reflected by the composition of ocean transport cargo. Maritime transport is generally associated with the carriage of high-volume, low-value goods. In recent years, however, the share of low-volume, high-value goods has grown over-proportionally (UNCTAD 2008).

At the same time, Jacks et al. (2008a, b) suggest that long-distance ocean trade of goods with low value-to-weight and low value-to-freight cost ratios such as iron ore, coking coal and steel products also have been impacted[99]. At 2008 ocean transport cost levels, they indicate a slowdown in 'back-and-forth-trade' of such goods which are transport cost intensive.

The overproportional effect rising transport costs have on low-value products can be seen in figure 7.2 which shows the demand curves of two different commodities.

Figure 7.2 Influence of Value and Demand Elasticity on Price



Source: Bardi et al. 2006: 271

On the one hand, the high-value commodity has a steeply sloping demand curve implying price inelasticity. The low-value commodity, on the other hand, has a gradual slope, implying price elasticity. When the price for transport increases from P1 to P2, only a small decrease (Q1 to Q2) is observed for the high-value product, while for the same increase in transport costs, a large decrease can be observed for the low-value product (Bardi et al. 2006: 271).

Kousnetzoff et al. (2008) analyse the relationship between oil price variation and the development of the composition of international trade during the 2000s. They find that on average, a 1% increase in transportation costs per ton leads to an increase in the value per ton of exported goods of about 1%. The authors also estimate that a 1% increase in oil prices leads to a 0.015% increase in the per ton value of exported goods. Therefore, the 7.5 fold increase of oil prices during the 1998 to 2008 period led to an increase of the per-ton value of goods exported to the U.S. by 3.1%.

7.3 The Link between International Transport Costs, Commodity Price Convergence/Dispersion and Trade Globalisation

The power of international trade to promote economic convergence between nations is viewed as one of the most venerable tenets of classical and neoclassical economics (Sachs and Warner 1995). There are different kinds of economic convergence, for instance factor price or income convergence and commodity price convergence which are linked to each other (Bourguignon et al. 2002; O'Rourke et al. 1996). Heckscher and Ohlin argued that commodity price convergence induces factor price convergence. According to Heckscher-Ohlin trade theory, significant global economic events first have an impact on relative commodity prices followed by an impact on relative incomes and factor prices (O'Rourke and Williamson 1999: 57; 2004).

The natural benchmark for a hypothetical perfectly integrated global economy[100] is that markets for goods, services and factors of production are perfectly integrated (Rodrik 2000). The above description is based on the law of one price (Bordo et al. 1999; Bradford and Lawrence 2004; Scholte 2005: 57).

For the dissertation topic commodity price convergence is of primary importance. Commodity price convergence can be defined as "the proposition that identical goods sold in competitive markets should cost the same everywhere when prices are expressed in terms of the same currency" (Sawyer and Sprinkle 2009: 365). Since economic globalisation can be described as the process towards economic globalism, it is closely linked with the process of commodity price convergence. Findlay and O'Rourke (2001) point out that commodity market integration implies that commodity prices should converge over time. Convergence of commodity prices will then, other things being equal, lead to increasing international trade volumes. In other words, as commodity prices converge, the globalisation of trade flows increases (Ben-David 1996; O'Rourke and Williamson 1999: 214; Sachs and Warner 1995).

Therefore, commodity market integration expressed by commodity price conversion/dispersion is widely accepted as the best measure of international market integration where price gaps reflect the relevant costs of doing trade between markets (Findlay and O'Rourke 2001).

Bergin and Glick (2007) measure the degree of global commodity price convergence between 1990 and 2005. The authors use data on prices for 101 tradable commodities in 108 cities in 70 countries for their analysis. They find a U-shaped pattern of commodity price convergence/dispersion for several sub-groupings of countries, selected regions, and selected commodity groups. Prices converge from 1990 to 1997 and then disperse from 1998 to 2005. Bergin and Glick also find that this time-varying pattern coincides remarkably well with oil price fluctuations (in other words: rising oil prices in the second half of the sample period reversed some of the convergence gains in the first half of the sample) and that high oil prices have an influence on price dispersion by increasing price wedges with growing distance. The results indicate that rising oil prices (the oil price variable is highly significant) have an impact on global price dispersion via the transport cost channel and that the rising price of oil during the 2000s led to an increase of the sensitivity of distance to trade.
The study of Bergin and Glick indicates that in addition to the impact on vertical specialisation and the composition of world trade, rising oil prices during the 2000s also had a negative impact on commodity price convergence, thereby affecting trade globalisation.

7.4 Globalisation and Regionalisation

Irrespective of peak oil and its impact on trade globalisation, regionalisation is a trend that has increasingly taken place parallel to globalisation since the 1980s (MacKinnon et al. 2008: 17). A trend towards regionalisation has become manifested in regional entities or regional integration agreements particularly in Europe (EU), the Americas (NAFTA, MERCOSUR) and Asia (ASEAN, APEC). In the early 2000s, the WTO notified a total of 114 regional trade agreements with almost 60% of world trade taking place within such agreements[101] (Bardi et al. 2006: 234; Bourguignon et al. 2002; Henderson 1992). In the recent past, regional trade has been growing (even) faster than inter-regional trade (Kumar and Hoffmann 2002: 45).
The difference between regionalisation and globalisation can be described as follows: On the one hand, globalisation refers to trans-continental and trans-regional networks, trade and financial flows, and interconnectedness. On the other hand, regionalisation refers to the intensification of patterns of interconnectedness and integration between states that have common borders and/or are geographically proximate. While trade flows and financial flows between the major economic blocks (Europe, North America, Asia Pacific) constitute economic globalisation, such flows within these blocks are referred to as regionalisation (McGrew 2008: 20).[102]
There are three alternative views on the relationship between regionalisation and globalisation (Bourguignon et al. 2002; Mirza and Zitouna 2009):
1. Regionalisation is a defence against or a brake upon globalisation.

2. Regionalisation is just one form of globalisation, maybe even a particularly strong form.
3. Regionalisation is a stepping-stone on the path towards multilateralism and thus an active agent of globalisation.

Regionalisation and globalisation do not necessarily contradict each other. In the recent past, regionalisation has rather accompanied globalisation (Frankel 1998; Gamble and Payne 1996; Scholte 2005: 77; 2008), thereby accentuating the increasing importance of regions as economic units within a globalising economy relative to the post-war model of integrated national economies (MacKinnon et al. 2008: 17). Therefore, regionalisation is one of the dominant features of global trade (Rodrigue 2009). However, the econometric evidence in chapter 6 indicates that, at least in the steel industry, regionalisation can also come at the cost of trade globalisation.

7.5 The Two Waves of Globalisation

Section 7.5 links the findings in chapter 6 to the history of globalisation and describes the lessons the past may hold for the future of trade globalisation. The section proceeds as follows: Section 7.5.1 describes the chronology and periodisation of the economic globalisation process. Section 7.5.2 then outlines the role of international transport costs in the globalisation process over time. Section 7.5.3 describes the early twentieth century globalisation backlash.

7.5.1 The Chronology and Periodisation of Globalisation – Recent Phenomenon, Long-Term Upward Trend or Cyclical Process?

There are three different approaches regarding the chronology of economic globalisation. The first approach characterises economic globalisation as a recent phenomenon that can be traced back to the 1960s (Scholte 2005: 2). Back then, largely independent national economic networks began to interconnect, a process that eventually culminated in the current global interdependent economic network (Castells 1993; 1996; Chase-Dunn et al. 2000; Sklair 1995). Contrary to proponents of this approach such as Drucker (1989) and King and Schneider (1991), most researchers in this field emphasise that the beginning of the economic globalisation process can be predated significantly.[103]

Some experts trace back globalisation to ancient history (Frank and Gills 1993). Yet other historians like Bentley (1996) refer to the late 15th century as the start of global economic history (Bairoch and Kozul-Wright 1996; O'Rourke and Williamson 2002). Most experts, however, backdate the beginning of the economic globalisation process to the nineteenth century (Henderson 1992; Keohane and Nye 2000; O'Rourke and Williamson 1999; 2004; Scholte 2005: 15). The second and the third approach to the chronology of globalisation both take up this stance.

The second approach characterises economic globalisation as a linear long-term upward trend from local to regional to national to international to global integration (Chase-Dunn et al. 2000). Advocats of this account like Robertson (1992) view the evolution of global economic integration in linear terms (Scholte 2005: 2).

The third approach describes economic globalisation as a cyclical process. From this perspective, the trend towards greater global economic integration is not monotonic. Contrariwise, globalisation is periodically interrupted by shocks like wars, economic depressions or political responses to the distributional effects of globalisation itself (Chase-Dunn et al. 2000; Findlay and O'Rourke 2001; Scholte 2008). A review of the respective literature (e.g. Artis and Okubo 2009; Baldwin and Martin 1999; Bird and Rajan 2001; Bordo et al. 1999; Bourguignon et al. 2002; Chase-Dunn et al. 2000; Estevadeordal et al. 2003; Findlay and O'Rourke 2001; Jacks et al. 2010; Krugman 1995; McGrew 2008; O'Rourke and Williamson 1999; Sachs and Warner 1995; Srinivasan 2002) yields that the third approach to the history of the globalisation process, which refers to multiple waves of globalisation, is most commonly accepted.

According to Artis and Okubo (2009: 91) "it has been commonly accepted that two waves of globalisation can be detected – one situated before World War I, and the other commencing at some point … after World War II to the current period."[104] The first wave of globalisation, also referred to as 'belle epoque', lasted from 1870 to 1914 and was superseded by the so called 'dark middle ages'[105] (1915-1959). This period was then superseded by the second wave of globalisation ('twentieth century renaissance') which lasts from 1960 until the present (Artis and Okubo 2009; Baldwin and Martin: 1999; Bairoch and Kozul-Wright 1996).

7.5.2 The Role of Transport Costs in the History of Trade Globalisation

The first wave of global economic integration was to a significant extent caused by decreasing trade barriers. In this context, section 7.5.2 describes the importance of international transport costs for triggering the first globalisation wave and compares the role transport costs played in the first phase of globalisation with their role during the second phase of the globalisation process.

Why is this analysis important? According to Scholte (2005: 121), "in order to anticipate possible future causes of globalization and to shape those processes in desired directions, it is necessary to understand the forces that have generated the development and brought it to its present position. Viable explanation provides grounds for sound prediction, prescription and action." In particular, it is necassary to take up a comparative perspective because in contemporary globalisation debates many economists "treat the phenomenon as if it is unique to our time, seemingly unaware of how directly the first great globalization boom speaks to the second. A conversation between the two is long overdue." (O'Rourke and Williamson 1999: 4).

During much of the nineteenth century and particularly during the first wave of globalisation, a significant and persistent decline in transport costs was taking place (Estevadeordal et al. 2003: 366) mainly due to technical innovations and investments in infrastructure (Baldwin and Martin 1999; Bourguignon et al. 2002).[106]

The robust decline of transport costs during this central episode of global economic history (Estevadeordal et al. 2003: 370) comprehended overland and maritime transport costs (Bordo et al. 1999; Findlay and O'Rourke 2001; Jacks et al. 2008b). Research on the first wave of globalisation has tracked freight rates reasonably well (Jacks et al. 2006). Estevadeordal et al. (2003) estimate a decline in general freight rates by roughly 30% between 1870 and 1913. Especially maritime freight rates fell considerably. The North freight rate index (North 1958) fell by 41% in real terms between 1870 and 1910 and the British index (Harley 1988) dropped by 70% in real terms between 1840 and 1910 (Bourguignon et al. 2002; O'Rourke and Williamson 2002). Both indexes cover ocean freight rates for the Atlantic economy and show a steady fall of ocean transport costs of about 1.5-2% per annum (Jacks et al. 2010: 128; O'Rourke and Williamson 1999: 35). According to Jacks and Pendakur (2008), maritime freight rates fell by 50% between 1870 and 1913. For instance, the price of transporting a bushel of wheat from New York to Liverpool was halved between 1830 and 1880 and was halved again between 1880 and 1914 (Baldwin and Martin 1999).

The reduction of international ocean freight rates was not limited to the Atlantic economy. Between 1870 and 1914, ocean transport costs also declined substantially on routes involving the Black Sea and for Asian trade routes (O'Rourke and Williamson 2002). Thereby, real freight rates fell most for core-periphery trade or rather long-distance trade (Chase-Dunn et al. 2000; Jacks et al. 2010; McGrew 2008: 4; Sachs and Warner 1995). Therefore, falling transport costs were a major force for the integration of world markets (Bordo et al. 1999). Table 7.1 shows that transport cost reductions were most significant for bulk trade commodities (Baldwin and Martin 1999).

Table 7.1 Transport Costs, 1830-1910

% of Production costs	1830	1850	1880	1910
Wheat	79	76	41	27.5
Bar Iron	92	71	33	19
Manuf'd Iron Goods	27	21	10	6
Cotton Thread	11	8.5	3.5	2.5
Cotton Textile	9.5	8	4.5	2

Note: Figures for Hypothetical 800 km Shipment.

Source: Bairoch 1989: 56-7, cited by Baldwin and Martin 1999

As indicated above, international transport cost reductions helped to overcome space and to reduce time of delivery (Jacks et al. 2006; 2010) and thus had a profound impact on international trade integration (Bourguignon et al. 2002). According to O'Rourke and Williamson (1999: 29) "*all* of the commodity market integration was due to the fall in transport costs between markets, and *none* was due to more liberal trade policy." In this context, Jacks et al. (2010: 136) argue that "rising tariffs partially offset declining freight rates" and Estevadeordal et al. (2003: 392) presume that the rise in international trade between 1870 and 1914 "would have been considerably ironed out if transport had remained steady. By this reckoning, transport costs have great power to explain the trade boom and bust."[107] As a result, "the spectacular transport revolution that took place across the nineteenth century … generated an equally spectacular convergence in commodity prices." (O'Rourke and Williamson 1999: 3)

During the second wave of globalisation, maritime shipping costs began to decline in the 1960s[108], increased between 1973 and 1985, then decreased until the early 2000s albeit at a slower rate than previously, and then increased again during the 2000s (Artis and Okubo 2009; Baldwin and Martin 1999; Bordo et al. 1999; Bourguignon et al. 2002; Findlay and O'Rourke 2001; Hummels 2001).

While declining international transport costs were the main driver of the first wave of globalisation, they may now contribute to a slowdown or partial reverse of trade globalisation (see econometric analysis in chapter 6).

7.5.3 The Early Twentieth Century Globalisation Backlash

World War I brought the first phase of economic globalisation to an abrupt end and was tantamount with a discontinuous break with the previous four decades.[109] However, there were already signs of a possible globalisation backlash prior to 1914 (Findlay and O'Rourke 2001). In fact, the globalising economy, prosperous and increasingly integrated as it was, already contained significant flaws (James 2002: 6) and there were precedent signs for the globalisation backlash and for the de-globalisation process that started in 1914 (O'Rourke and Williamson 1999: 117, 186). Essentially, the main flaws were the result of increasing demand for trade protection throughout the industrialising world especially during the 1880-1895 period, and a growing hostility towards immigration in certain countries due to increasing inequality in income distribution (Bourguignon et al. 2002; James 2002: 6). The main political responses were the imposition of tariffs on primary and manufactured commodities, and a gradual escalation in immigration restriction (O'Rourke and Williamson 1999: 94). Despite innovations in transportation technology and information and communication technology, the process of trade integration eventually slowed down. After 1914 and especially during the interwar period, the control of both trade and factor flows was further tightened (Williamson 1999), thereby accelerating the already initiated de-globalisation process. Furthermore, the collapse of international financial and commodity markets (Bordo et al. 1999; Jacks et al. 2008b) during the 'dark middle ages' (1914-1945) was fostered by multiple financial, political and military shocks (Bairoch and Kozul-Wright 1996; Henderson 1992). In this context, especially the 'triple whammy' of World War I (1914-1918), the Great Depression[110] (1929 to mid-1930) and World War II (1939-1945) contributed to the reverse of economic globalisation (Bird and Rajan 2001; Estevadeordal et al. 2003; Scholte 2005: 117).

International trade levels reached a high point in 1913 which was not surpassed again until the 1970s (Bairoch and Kozul-Wright 1996; Bordo et al. 1999; Krugman 1995). For many countries such as Australia, Switzerland and the UK, 1913 export levels were still unattained as late as 1973 (O'Rourke and Williamson 1999: 30) and some countries achieved trade levels comparable to those in the first globalisation period as late as in the mid-1990s (Jacks et al. 2008a).

A noteworthy parallel between the first and second wave of globalisation seems to be the mind-set of many with regard to the persistence of the economic globalisation process towards increasing economic globalism. A few years after the end of the first globalisation period, Keynes (1919: 10) noted that many people regarded the process of globalisation "as normal, certain, and permanent, except in the direction of further improvement, and any deviation from it as aberrant, scandalous and avoidable." This view is probably also shared by many when it comes to the current globalisation process. According to Sutcliffe and Glyn (2003: 3), nowadays "almost everybody seems to believe that globalization is happening at a headlong pace, and is the defining characteristic of contemporary capitalism. Some like it, others see it as the source of all evil. But most see it as both unprecedented and irresistible."[111] In reference to this zeitgeist, O'Rourke and Williamson (1999: 286) point out that especially "politicians, journalists, and market analysts have a tendency to extrapolate the immediate past into the indefinite future, and such thinking suggests that the world is irreversibly headed toward ever greater levels of economic integration. The historical record suggests the contrary." According to O'Rourke and Williamson (1999: 93), history reveals that economic globalisation can plant the seeds of its own destruction. Towards the end of the first wave, globalisation undermined itself politically (Bourguignon et al. 2002: 31), thereby destroying the globalisation achievements made in three decades, between 1914 and 1945 (O'Rourke and Williamson 1999: 2).

In view of the dissertation topic, it is important to recognise the fact that the evolution of globalisation is not necessarily linear[112] and that a globalisation backlash is not only possible in theory but has already occurred in the past. Scholte (2005: 119) suggests that the exhaustion of natural resources such as crude oil or climate change may put a brake on globalisation in the long and maybe even in the medium term. And Keohane and Nye (2000: 118) stress that following cataclysmic events, trends towards global economic intergation can be set back or even reversed as happened in earlier phases of globalisation. Finally, Bird and Rajan (2001: 16) emphasise that another 'globalisation backlash' cannot be discounted out of hand.

Sometimes looking at history can draw lessons for the present (Estevadeordal et al. 2003). So what about current trade globalisation? Is it possible that history repeats itself to the effect that globalisation undermines itself again? In case the maximum of conventional oil production has been reached, will rising oil prices lead to a regionalisation of international trade at the cost of long-distance trade? If so, the analysis in chapter 6 indicates that trade flows of bulky goods with comparatively low value-to-weight ratios such as steel will be among the most affected.

7.6 Summary

The following causal chain shows how peak oil affects trade globalisation (see figure 7.3). Peak oil leads to rising oil prices which then lead to increasing fuel costs. Increasing fuel costs lead to rising international transport costs. Rising international transport costs lead to less vertical specialisation, especially when the locations in a given vertical specialisation network are widely scattered. Moreover, surging international transport costs influence the composition of world trade in a way that previously non-tradeable goods from geographically remote countries which became tradeable due to declining transport costs in recent decades may become non-tradeable again. Spiraling international transport costs also lead to commodity price dispersion rather than commodity price convergence.

Figure 7.3 Chain of Causation

Source: Author's illustration

The reduction of vertical specialisation, the changing composition of international trade and commodity price dispersion contribute to an increase of regional trade at the cost of long-distance trade. As a consequence, trade globalisation is (at least partially) reversed.

In coming years, trade globalisation may not just be accompanied by regionalisation as in recent decades. On the contrary, increasing regionalisation may also come at the cost of trade globalisation or long-distance trade, at least in the most vulnerable industries.

In this context, the history of economic globalisation, which shows that the process of globalisation is not necessarily linear and that the immediate past and the present cannot be extrapolated into the indefinite future, should be kept in mind.

8 Outlook and Policy Recommendations

Chapter 8 provides an outlook (8.1) and policy recommendations (8.2).

8.1 Outlook

Between 1999 and 2008, oil prices increased rapidly at an annualised rate of 20.6% (Ma and Van Assche 2010). At the height of the oil price spike, prices increased from \$50 to \$147 between January 2007 and July 2008. In 2008, oil prices increased by 67% within six months (McNally and Levi 2011). By any measure, the oil price increase during the 2000s qualifies as one of the largest on the record (Hamilton 2009).

Historical oil price shocks were primarily due to temporary disruptions of oil production as a result of geopolitical events (OECD/ITF 2008). The last period of rising oil prices, however, was mainly due to the following factors (Donovan et al. 2008; Hamilton 2009; Kendall 2008; Pellényi et al. 2008):

- increasing oil demand of developing countries (particularly China and India) fuelled by subsidies which insulate consumers
- decreasing oil production from conventional sources
- increasing replacement of decreasing conventional production by unconventional oil supply leading to higher production costs
- limited spare capacity
- a failure of total production (conventional and unconventional) to increase between 2005 and 2007

The above-listed factors and a greater concentration of oil reserves in a shrinking number of countries are going to continue to fundamentally change the energy landscape in coming years (Gangnes et al. 2011a; Kendall 2008). In its latest projection, the IEA estimates that in 2035, average oil prices will be at \$125 in year-2011 dollars (the estimate is \$140 if Iraq does not manage to increase production significantly) and at \$215 in nominal terms (IEA 2012). Moreover, the majority of more short-termed projections expect average oil prices to exceed \$90 by 2015 and \$100 by 2020 with further increases thereafter (Gangnes et al. 2011a).

In addition to high average price levels, oil price movements are expected to be increasingly characterised by sharp spikes and troughs (OECD/ITF 2008; Sentance 2009). The first boom-and-bust cycle of this kind might have occurred between 2007 and 2011. As already described above, between January 2007 and July 2008, oil prices increased from \$50 to more than \$140 only to crash to just over \$30 by the end of 2008. In early 2011, oil already sold for \$120 again (Gangnes et al. 2011a; McNally and Levi 2011). According to McNally and

Levi (2011), “the world will be stuck with wild price swings for the foreseeable future. Already, the consequences for economics and geopolitics are stark. Big shifts in oil prices complicate economic decisions. Companies in many sectors avoid investing in new facilities and equipment that may be profitable at low oil prices but are useless if prices soar.”

Among the industries most affected may be energy- and transport-intensive industries such as the chemical, industrial machinery, non-metallic, basic metal (e.g. iron, steel, non-ferrous metals such as copper or zinc), cement, rubber, paper, fertiliser, apparel, footwear, toy, furniture, agriculture/food (e.g. fruits, vegetables, sea food, cut flowers), and of course the transport industry (Gangnes et al. 2011a; Pellényi et al. 2008; Rubin and Tal 2008). Especially the most affected industries need to develop strategies to adapt to the changing energy environment as best as they can (McNally and Levi 2011). One such strategy would be the restructuring of global supply chains, if existing, into regional supply chains to reduce transport distances and transport costs (Rugman et al. 2009).

There is a positive feedback loop between transport growth and economic growth because the mobility of goods, services and people enables economic activity to increasingly take place (Kendall 2008). Thereby, the transportation sector is the most exposed part of an economy to oil prices (OECD/ITF 2008) with 50% of worldwide crude oil output converted into transportation fuel and 95% of the primary energy consumed in transportation derived from crude oil (Beverelli 2010; Kendall 2008). However, fuel substitution in the transport sector is inherently very limited and a transition towards alternative fuels may take decades rather than years (McNally and Levi 2011; OECD/ITF 2008; Pellényi et al. 2008).[113]

Increasing transport costs, which in many cases already surpass tariffs as a barrier to international trade (Beverelli 2010), may seriously test the sustainability of the current global logistical organisation in coming years (Braithwaite 2008).

The European Commission already plans to re-industrialise the European continent. Until 2020, the relative share of industrial production to GDP shall increase from 15% to 20%. The European Commissioner for Industry and Entrepreneurship Tanjani calls for a ‘third industrial revolution’ in Europe (Eder 2012). France already has a Ministry for Re-Industrialisation (Wüpper 2013). The U.S. might also regain some of its industrial power. While industrial production in the U.S. became less significant in recent decades, the weak U.S. Dollar and increasing productivity may have initiated a re-industrialisation process. Experts expect that between two and three million additional jobs will be created in industrial production and that increasing domestic production will lead to decreasing U.S. imports in coming years (Stocker 2013b). Thereby, increasing international transport costs may foster the realignment of worldwide industrial production.

According to Hall et al. (2006: 1401) “improvements in transport technologies, the massive enlargement of infrastructure and falling transport costs, not least thanks to cheap oil, changed the role of transport in the second half of the 20th century. Paradoxically, these improvements were very effective in putting transport out of consideration in economic geography." The role of transport costs for economic geography, however, may have changed in recent years.

Economic globalisation consists of three factors, increasing global financial flows, increasing global movement of people, and increasing global trade. At the time of this writing, the stability of the international financial system is tested seriously and in Western countries, resistance against the free movement of people is on the rise. 1913 was the last year before the first wave of globalisation started to crumble. One-hundred years later, what will 2013 and coming years hold for the second wave of globalisation? The consequences of peak oil for international trade volumes (at least for some industries such as the worldwide steel industry) may reveal that another element of economic globalisation is built on shaky ground.

8.2 Policy Recommendations

In reference to the findings of the dissertation, the following policy recommendations are put forward.

Countries following an export-oriented growth strategy should implement trade-cost reducing policies (Ma and Van Assche 2010) to remain competitive not only regionally but also in global markets.

First and foremost, such policies should focus on increasing the competitiveness in the freight market. When it comes to maritime transport, customs procedures can be simpliefied to reduce transit times, port infrastructure can be improved via private and public investments, port duties can be reduced, and the fuel efficiency of the shipping fleet can be improved. Similar policies shoud be adopted to improve the infrastructure of airports and the fuel efficiency of cargo planes. With regard to domestic transportation, the road, waterway and railway infrastructure of a given country should also be strengthened and the fuel efficieny of trucks and trains should also be improved. These measures should be adopted to reduce the impact domestic and international transport costs have on final selling prices (Guerrero de Lizardi and Padilla-Pérez 2010).

In the context of transport cost reductions, another option would be the reduction of upstream trade distances where possible via a sourcing policy with a focus on more proximate sourcing partners.

Parallel to transportation costs, a country adopting a trade-cost reduction policy should also focus on further tariff reductions. Both tariffs and transport costs act as a global tax (Mirza and Zitouna 2009). Therefore, the reduction of tariffs would have the potential to ease the impact of rising transport costs on long-distance trade. In this context, the beginning negotiations of the European Union and the United States about a free-trade zone come to mind.

Second, a strategy to improve international competitiveness via the reduction of production costs for manufactured products may be considered. Lutz and Meyer (2009) find that improving international competitiveness may help to reduce the negative impact of oil prices on international trade. The competitiveness of an economy can be improved by a reduction of labor costs, the education of highly qualified human resources and/or an increase in labor productivity. Moreover, the energy efficiency of an economy may also be improved to increase international competitiveness. This does not only account for the transport sector but also for the generation and use of electricity.

In case the above described measures do not help to sustain the long-distance trade volumes of a given country, an alternative strategy that may be adopted is to initiate measures that help to increase regional trade to compensate the reduction of long-distance trade.

By no means, should long-distance trade be subsidised. If market forces make impossible the preservation of long-distance trade and vertical specialisation in its current form no subsidies should be used to artificially maintain trade globalisation. From an economic perspective trade globalisation can be justified as long as it is economically viable. However, globalisation should not become an end in itself. That is, global trade flows should not be preserved artificially for ideological reasons in order to create the ‘global village’. When it comes to trade globalisation, one should also keep in mind the adverse ecological costs of long-distance trade. In this context, high oil prices following peak oil can be viewed as a tax on pollution (Mirza and Zitouna 2008) and an increase of regional trade flows at the cost of long-distance trade should be appreciated.

If international trade increasingly regionalises in coming years, this will create a window of opportunity for countries geographically proximate to economic powerhouses such as the U.S. and Western Europe (Guerrero de Lizardi and Padilla-Perez 2010). In that regard, countries from Central America, the Caribbean or Eastern Europe come to mind. Countries from these regions may increasingly capitalise on a regionalisation of trade flows, especially if a re-industrialisation process of the U.S. and Western European countries would materialise as indicated above (see 8.1).

9 Conclusion

The dissertation evaluates the impact of peak oil on the geography of international trade by analysing steel exports to the United States. The hypothesis tested is that peak oil involves rising oil prices and international transport costs which will eventually lead to an increasing regionalisation of international trade flows at the cost of long-distance trade.

Despite the importance of the link between persisting high oil price levels and the geography of world trade, so far remarkably little research has been conducted for that matter. Particularly, there is a gap in the literature with regard to the impact of high oil price levels during the 1998-2008 period on international trade volumes at the industry level. The dissertation contributes to filling that gap. At the time of this writing, no other study has analysed the impact of high oil prices during the 2000s on the trade flows of an industry. The dissertation therefore provides new insight about the impact of high oil prices through the (ocean) transport cost channel on international trade flows in the steel industry.

The worldwide steel industry is a logical candidate for analysis. Steel production involves long-distance upstream trade in steelmaking raw materials with a low value-to-weight ratio such as coking coal and iron ore for steelmaking companies in many countries and long-distance downstream trade for steel. Steel is also a commodity with a comparatively low value-to-weight ratio. Therefore, at high oil price levels the relative share of transport costs to final selling prices is overproportionally high for both the upstream trade of coking coal and iron ore and the downstream trade of steel so that long-distance trade of steel may be impacted via the ocean transport cost channel. Moreover, steel is an essential input for most manufacturing activities and for infrastructure development and therefore is a key ingredient for economic growth.

The VEC model is used to analyse the impact of a shock in real oil prices on steel exports to the United States for the time period between 1998 and 2008. Thereby, impulse response and variance decomposition estimates are analysed per steel exporting region (for 8 regions), per steel export country (for 64 countries) and per steel export category (for 18 countries).

Statistical analysis of the impulse response estimates reveals that following an oil price shock, steel exports to the U.S. decrease for the majority of the African, Asian, C.I.S., European, Middle Eastern, and Oceanian countries analysed. On the other hand, steel exports to the U.S. increase for the majority of South American countries and for all North American countries analysed.

Moreover, following a shock in real oil prices, steel exports to the U.S. decrease for the majority of steel export categories of the selected African (South Africa), Asian (China, Japan, South Korea, Taiwan), C.I.S. (Russia, Ukraine), European (Belgium, France, Germany, Italy, Netherlands, Spain), Middle Eastern (Turkey), and Oceanian (Australia) countries. On the other hand, steel exports to the U.S. increase for the majority of steel export categories of the selected North- (Canada, Mexico) and South American (Brazil) countries. Thereby, a significant share of the impulse response estimates is statistically significant.

The analysis also reveals that the explanatory power of the oil price variable for the steel export variable is moderate or high for each region and for the steel export categories of the countries analysed (with the exception of Taiwan and Ukraine).

Finally, after classifying the steel export categories into low- and high-value categories, price patterns are identified for the majority of the 18 countries selected for analysis by category where, in line with economic theory, exports in low-value categories are affected overproportionally when compared with high-value categories.

The findings show that during periods of rapidly rising oil prices, steel export volumes to the United States decrease for countries/regions geographically distant to the U.S. and increase for countries/regions geographically close to the United States. That is, when oil prices rise to a certain extent, international steel trade flows to the U.S. increasingly regionalise. Moreover, the evidence suggests that the explanatory power of oil prices for steel exports to the U.S. is significant. Finally, the evidence suggests that price patterns also play a role in the realignment process of international trade flows in the global steel industry. The findings described above are in line with economic theory and indicate that due to peak oil trade globalisation, at least in the steel industry and other industries that are vulnerable to increasing transport costs, may be at risk.

In this context, the following policy recommendations can be made. Countries following an export-orientied growth strategy should implement trade cost reducing policies. For example, the competitiveness in the freight market should be improved, tariffs should be reduced further, and production costs for manufacturing products should be reduced to remain competitive in global export markets. If the above-mentioned measures do not help to sustain a country`s long-distance trade volumes, measures that help to increase regional trade to compensate the reduction of long-distance trade should be adopted. By no means should long-distance trade be subsidised to artificially preserve long-distance trade for ideological reasons. In this regard, the ecological benefits of an increase in regional rade should be kept in mind.

With regard to the steel industry, more research will be necessary to gain further insight into the working mechanism of the transport cost channel for different countries and regions. Moreover, research should also be conducted to evaluate the impact of peak oil on the geography of trade for other industries. Considering the paucity of existing literature at the industry level, the link between peak oil and international trade patterns should be a fruitful area for research in coming years.

Notes

1 The growing intensity of the peak oil debate is reflected by a broadening range of participants. Initially, the debate was rather limited to geological circles (exemplarily, see Campbell and Laherrère (1998) and Deffeyes (2005)) and then widened to economic circles (e.g. Rubin 2009; 2012) with a time delay. The issue has also increasingly been addressed by governmental institutions (UK ITPOES 2008). For instance, recent papers have been published by or on behalf of the U.S. Department of Energy (Hirsch et al. 2005; Hirsch 2007), the British House of Commons (APPGOPO 2008), the National Assembly for Wales (Clubb 2008), the Parliament of South Australia (Kanck 2008), the Parliament of New Zealand (Smith 2010), the United States Joint Forces Command (USJFCOM 2010), the German Military Forces (Bundeswehr Transformation Centre 2010), and the German Federal Institute for Geosciences and Natural Resources (BGR 2008).

2 In most studies focusing on the impact of peak oil on economic developments, it is common practice not to engage in discussions when exactly peak oil will occur (e.g. Friedrichs 2010; Kerschner and Hubacek 2009). This debate should be left to geologists. Exemplarily, the reader is referred to a recent paper by Hirsch (2008) in which shortage scenarios are discussed. Resource scarcity and the occurrence of peak oil at some point in time, however, are accepted as a fact.

3 Some experts argue that peak oil may already have occurred (Aleklett et al. 2010; Leigh 2008).

4 A considerable number of research articles exist about the macroeconomic effects of oil price shocks. Extensive reviews of the literature can be found in Sauter and Awerbuch (2003), Hamilton (2005), and Kilian (2007).

5 Conventional oil production has been stagnant in recent years (Hamilton 2009)

6 If it takes one or more than one barrel of oil to extract one barrel of oil (e.g. due to the geographical location of the resource) it is uneconomic to extract oil from an oil deposit (Friedrichs 2010; Leigh 2008).

7 Complete economic integration would therefore require free trade, free capital movements and free migration (Henderson 1992).

8 For a detailed description of the MAGIC software and the applied methodology, the reader is referred to Hernández and Romero (2012).

9 The data provided by Feenstra can be accessed at the NBER website http://www.nber.org/data/ and are described in Feenstra et al. (2001).The dataset provided by Hummels is available from http://www.mgmt.purdue.edu/faculty/hummels.

10 The economic impact oil price volatility has been analysed in a number of articles, for example Lee et al. (1995), Ferderer (1996), Guo and Kliesen (2005), Elder and Serletis (2010), Henriques and Sadorsky (2011), Mork (1989) and Mork et al. (1994).

11 Price dispersion also increases as a result of rising tariffs. Common borders, common language, inner-country trade, and the participation of countries in regional trade agreements and/or currency unions are supporting factors of price conversion.

12 Moreover, Asia reduced its average tariff rate from 30% to 14% between the early 1980s and the late 1990s, and Latin America reduced its average tariff rate from 31% to 11% during the same time period (Clark et al. 2002).

13 Another study by Sampson and Yeats (1977) finds that transport costs pose a much greater trade barrier to geographically isolated Australia than tariffs.

14 According to Stopford (2009: 119) and Behar and Venables (2010), the reasons for the declining maritime transport costs between 1950 and 1995 are increasing ship size, specialised vessels, improved on-board technology, and more efficient engines.

15 Hummels (2007a,b), however, finds that although U.S. freight rates decreased steadily in real dollars per ton they did not fall relative to the value of goods shipped. In this context, Behar and Venables (2010: 20f.) note: "While historical studies suggest that the contribution of falling trade costs to the growth of trade is smaller than might have been expected, the puzzle is resolved by the fact that the measured fall in trade costs is quite low. Looking back, there are several reasons for this. One is the continuing importance of fuel costs. A second is that it is the fall in trade costs relative to the value of goods shipped that is the key variable, and it is not obvious that technical advance in transport has been consistently more rapid than technical progress in other areas. Finally, much of the technical advance in transport has gone into improved quality (speed and reliability) rather than lower cost."

16 A detailed description of the ocean transport cost categories can be found in Stopford (2009, chapter 6).

17 The term 'bunker' is defined as the "fuel oil burned in the ship's main engine." (Stopford 2009: xxi)

18 In the UNCTAD (2008: 25f.) maritime report, the consequences of the oil price-fuel cost relationship for maritime transport in 2007/2008 are described as follows: "With over 80 per cent of world merchandise trade by volume, estimated to be carried by sea, the impact of rising fuel costs on maritime transport is of great relevance. Like other modes, maritime transport relies on oil for its propulsion. Rising oil prices have an immediate effect on ship bunker cost levels as well as carriers' operating costs and management strategies. Reflecting the rising oil prices, by the end of 2007, prices for bunker fuel oil (380 cst) had increased by 73 per cent in Rotterdam and 76 per cent in Los Angeles compared to the same period during the previous year. … The fuel cost burden for the shipping sector and therefore for trade, could be significant given the share of fuel costs in a ship's overall costs."

19 The relative share of fuel costs could further increase in case environmental measures are implemented. If the new fuel standards agreed upon by the International Maritime Organisation are implemented, costs for low sulphur fuels to be used in Emission Control Areas will double the price for bunker fuel (WSC 2008).

20 In this context the term, 'operating costs' stands for the sum of fixed and variable shipping costs.

21 In accordance with new neoclassical growth theory, which views factor endowment as a key element for the comparative advantage of a given country, and new trade theory, which attributes comparative advantage and economies of scale equal importance when it comes to explanations of why countries trade, comparative advantage is still the most important theoretical explanation for predicting trade flows (Hernández and Romero 2012).

22 Distance can be defined as "the extent of territory separating territorial places." (Scholte 2008: 1480).

23 Apart from distance, there are additional geographical barriers or characteristics which usually have an impact on general transport costs but are not related to ocean transport costs, for example the cost of being landlocked or common borders (Behar and Venables 2010: 4;

Held et al. 1999: 5; Radelet and Sachs 1998). Limao and Venables (2001: 463) find that for the median landlocked country, transport costs are 55% higher than for the median costal economy, while trade volumes are 60% higher for the average coastal country, thereby accentuating the importance of maritime transport for international trade. During the 1990s, there were no landlocked countries among the top 15 exporters (Radelet and Sachs 1998). Being landlocked also means that goods have to cross at least one border to have access to ocean transport. This implies costs for crossing a border (Behar and Venables 2010: 13).

24 The use of distance as a measure for transportation costs is, amongst other things, due to the severely limited data availability of direct transport cost measures. Using distance as a substitute for transport costs, however, has some limitations: First, transport costs are also influenced by other factors than distance (Geraci and Prewo 1977; Moneta 1959). Moreover, geographic distance does not only capture transportation costs of geographic space, but also other economic costs such as the acquisition of distant market information, communication with distant agents or different preferences over commodities (Anderson and van Wincoop 2004; Tanaka 2010). Therefore, using distance as a proxy for transportation costs may result in an underestimation of the sensitivity of bilateral trade flows to transportation costs (Geraci and Prewo 1977). Distance, however, remains an important determinant of international transport costs and has been used in many studies about freight rates (Hummels 1999a, 2001; Limao and Venables 2001; Micco and Pérez 2001; Wilsmeier and Martinez-Zarzoso 2010).

25 The sensitivity between distance and transport costs is also relevant for the location of economic activity. According to Quinet and Vickerman (2004: 131), "the classic theory gives transport an essential role in the choice of location for firms: firms locate in the place which enables them to minimize the total cost of transport, taking into account both the supply of inputs, including labour, and the delivery of outputs."

26 For a landlocked country, transport costs even rise by $2,170 or almost 50% of average costs for an additional 1,000km (Clark et al. 2002; Limao and Venables 2001). Moreover, Martinez-Zarzoso et al. (2003) study the transport costs for exports of ceramic textiles from Spain and find that transport costs increase with growing distance and poor infrastructure (Wilsmeier and Martinez-Zarzoso 2010).

27 The gravity model of international trade is a model using distance as an explanatory variable for bilateral trade. The model has been empirically used to analyse international trade since the early 1960s (Limao and Venables 2001). It is one of the most robust and extensively studied models of international trade (Behar and Venables 2010), one of the most successful empirical models in economics (Jacks et al. 2010), it has a strong general theoretical backing (Anderson and van Wincoop 2003, 2004; Jacks et al. 2010; Krugman 1995), and is the standard analytical framework for the prediction of bilateral trade flows (Limao and Venables 2001).

28 Besides trade distance, geographical isolation also plays a role. Wilsmeier and Martinez-Zarzoso (2010) find that the impact of being peripheral in the maritime network may be more significant than the impact of trade distance. Radelet and Sachs (1998) also find that geographic isolation and subsequently higher transport costs hamper the efforts of countries to increase manufacturing exports. On the other hand, high transport costs as a result of geographic isolation can also act as a protection against imports (Conlon 1982).

29 This view is also shared by Rodrigue (2009) in view of the Asia Pacific Region where economic development has been the main driver of transport growth in recent years. As a result of increasing raw material and energy imports and increasing manufacturing exports, there has been a surge in long-distance trade. The UNCTAD (2009) report also links the rapid growth of world-ton-miles (a plus of 43% between 2000 and 2008) to the economic

rise of developing countries such as China and India which increasingly import sources from distant locations like Latin America and Africa.

30 In other words, low transport costs give commodity trade place-utility. This phenomenon is referred to as the 'Law of Squares in Transportation and Trade' or Lardner's Law. Bardi et al. (2006: 19) define Lardner's Law as follows: "Reductions in transportation costs will encourage market areas to purchase products from distant suppliers that might otherwise be produced locally. The reduction in transportation cost is actually much greater for long distances than for short ones because of the fixed charges. … If a supplier can cover the transportation cost of a certain amount in his or her price range, an increase in the distance over which this given amount will cover the transport of goods will increase the market area of the product in an even greater ratio."

31 Ocean transport makes up 99% of world trade by weight and a majority of world trade by value (Hummels 2007b).

32 North America and Europe have the most efficient ports followed by the Middle East and East Asia and the Pacific (Clark et al. 2002).

33 Rodrigue and Browne (2008: 177) argue that the trend of increasing ship size in the bulk trades is coming to an end. This may be due to the fact that at some point economies of scale start to diminish with increasing ship size. Using bigger ships then stops paying off (Stopford 2009: 59).

34 The costs per ton of cargo depend on the annual costs of a ship and the annual bunker costs consumed which are divided by the tons of transported cargo (Stopford 2009: 412):
costs per ton = ship costs per annum + bunker costs per annum / tons transported per annum

35 Pedersen (2001: 86) argues that "although the average per unit costs of transport has been reduced, overall transport costs have generally not decreased, because the amount and length of transport have increased as rapidly as the unit costs have decreased. Thus in spite of reduced unit transport costs the size of the transport sector as a percent of GDP has generally not decreased, and the availability of infrastructures and services has become increasingly important."

36 Together with declining international transport costs, trade liberalisation or tariff reductions top the list of usual suspects when it comes to the causes of post-Second World War trade growth (Hummels 1999b). U.S. tariffs on steel imports, however, have not been included in the analysis. During the sample period (see 4.2), there has been only one significant (temporary) change in U.S. steel import tariffs. In March 2002, the Bush Administration announced temporary tariffs on U.S. steel imports under section 201 of the 1974 Trade Act (The White House 2002). The tariffs announced were between 8%-30% on various steel products (Rich 2002). Prior to the newly imposed tariffs, the average tariff rate on U.S. steel imports was between 0%-1%. The World Trade Organisation (WTO) declared the tariffs imposed illegal due to the violation of international tariff treaties and allowed the countries affected by the tariffs to retaliate (Ackman 2003; Tran 2003). In order to avert a looming trade war, President Bush lifted the tariffs in December 2003 (The White House 2003). Because the tariffs were only in place for a short time period and were then lowered again to 0%-1% (in fact, there are no tariffs at all on the vast majority of steel products) (USTIC 2012, chapters 72, 73), a tariff variable has not been included because it can be assumed that its explanatory power for the variation in U.S. steel imports would have been quite limited. Prior to the period under investigation, tariffs on U.S. steel had already been reduced substantially in multiple rounds of GATT negotiations (Bourguignon et al. 2002; Findlay and O'Rourke 2001).

37 In 2008, the main steel producers were China with 38% of worldwide steel production followed by Japan (9%) and the U.S. (7%) (UNCTAD 2009).

38 The countries which have been excluded due to their low export frequency are Albania, Antigua, Aruba, Bahamas, Bahrain, Barbados, Belize, Bosnia, British Virgin Islands, Cayman Islands, Cook Islands, Croatia, Cyprus, Equatorial Guinea, Faroe Islands, Gabon, Georgia, Grenada, Haiti, Iran, Jamaica, Jordan, Kenya, Kyrgyzstan, Lebanon, Liechtenstein, Malta, Marshall Islands, Mauritius, Morocco, Mozambique, Netherlands Antilles, Nicaragua, Niger, Nigeria, Paraguay, Sao Tome, Senegal, Serbia, Somalia, Sri Lanka, Syria, Tajikistan, Tokelau, Tonga, Tunisia, Vietnam, Yugoslavia and Zimbabwe.

39 The countries which have been dropped from the analysis due to data availability problems and/or currency exchanges are Belarus, Greece, Macedonia, Moldova, Oman, Slovenia and Venezuela.

40 In 2008, 90.9% of global crude steel was produced in the 64 countries included in the analysis. From a regional point of view, the datasets represent 98.4% of crude steel production in the EU, 37.7% of other European production, 96.3% of C.I.S. production, 26.4% of North American production, 90.9% of South American production, 88.4% of African production, 73.3% of Middle Eastern production, 99.8% of Asian production, and 100% of Oceanian production. The 64 countries selected also represent 94.8% of global exports of semi-finished and finished steel products in 2008. Regionally, they represent 98.6% of the EU's total exports, 41.7% of exports of other European countries, 95.6% of exports from the C.I.S., 53.3% of North American exports, 93% of South American exports, 88.5% of African exports, 92.7% of Middle Eastern exports, 100% of Asian exports, and 100% of Oceania's exports.

41 The 18 countries chosen for a more in-depth analysis of steel exports to the U.S. by product category represent 78.2% of global crude steel production in 2008 and 75.8% of global steel exports in 2008.

42 These 14 countries are China (56,304mt), Japan (36,923mt), Ukraine (28,648mt), Germany (28,639mt), Russia (28,429mt), Belgium (21,235mt), South Korea (19,718mt), Turkey (18,535mt), Italy (18,040mt), France (17,125mt), Taiwan (10,038mt), the Netherlands (10,029mt), Spain (9,456mt), and Brazil (9,152mt). Because the analysis focuses on steel exports to the U.S., the United States (11,963mt), which were the 11th largest steel exporting country in 2008, have not been included. Canada (7,440mt), Mexico (5,993mt), South Africa (2,188mt), and Australia (1,421mt) complete the list of 18 countries. Canada and Mexico have been included, because they have common borders with the United States and are members of NAFTA. South Africa has been chosen because it is the only African country with significant steel exports to the United States. Australia has been included, because it is the largest producer/exporter of coking coal and iron ore, the two commodities which are most important for the steel production process and because it is the largest Oceanian steel exporter.

43 It is noteworthy that none of the main exporting countries is landlocked. Two countries have a common border with the U.S. (Canada, Mexico), and two countries are Anglophone (Australia, Canada). In terms of the stage of economic development, eleven countries are industrialised (Australia, Belgium, Canada, France, Germany, Italy, Japan, the Netherlands, Spain, South Korea (Tiger State), Taiwan (Tiger State)) and seven are newly industrialising (Brazil, China, Mexico, Russia, South Africa, Turkey, Ukraine).

44 A notable exception are import data from Canada. The U.S. derives its statistics on imports from Canada's export statistics while Canada derives its statistics on imports from the U.S. export statistics on the basis of the U.S.– Canada Data Exchange. According to the

U.S. Census Bureau, as a result of the data exchange between both countries, the quality of import data has increased. For more information on the U.S. – Canada Data Exchange, the reader is referred to Mozes and Oberg (n.d.).

45 The HS "is an international nomenclature for the classification of products. It allows participating countries to classify traded goods on a common basis for customs purposes. At the international level, the Harmonized System (HS) for classifying goods is a six-digit code system. … The Harmonized System was introduced in 1988 and has been adopted by most of the countries worldwide." (United Nations 2010)

46 "The SITC is a statistical classification of the commodities entering external trade designed to provide the commodity aggregates needed for purposes of economic analysis and to facilitate the international comparison of trade-by-commodity data. The Harmonized System and SITC Revision 3 are interrelated. The rearrangement of import and export data reported in terms of the Harmonized System into the SITC allows for an additional means of comparison between the U.S. and its trading partners in terms of commodity classification and trade statistics. ... Within the SITC framework, 'Manufactured Goods' includes all products classified in groups 5 through 9." (U.S. Census 2010b)

47 The U.S. Census Bureau defines the customs value as "the price actually paid or payable for merchandise when sold for exportation to the United States, excluding U.S. import duties, freight, insurance, and other charges incurred in bringing the merchandise to the United States. The term 'price actually paid or payable' means the total payment (whether direct or indirect, and exclusive of any costs, charges, or expenses incurred for transportation, insurance, and related services incident to the international shipment of the merchandise from the country of exportation to the place of importation in the United States) made, or to be made, for imported merchandise by the buyer to, or for the benefit, of the seller." (U.S. Census 2012b)

48 The U.S. steel import customs value datasets are published in nominal U.S. Dollars and need to be adjusted for inflation. Therefore, the datasets expressed in current dollars have been deflated by using the U.S. Consumer Price Index (CPI). The CPI is the most widely used measure of inflation (U.S. Bureau of Labor Statistics 2001) and is also used as a deflator in publications with similar content (e.g. Beverelli 2010). Data and information on the CPI are published on the website of the U.S. Bureau of Labor Statistics, http://www.bls.gov/CPI.

49 The series is constantly updated and revised.

50 In January 2001, category 20 (Line Pipe) was split up into sub-categories (20A: Line Pipe > 16 Inches In Diameter; 20B: Line Pipe ≤ 16 Inches In Diameter; 20C: Line Pipe – Not Specified). However, a category can only be included in the analysis when observations are available for the whole sample period. Therefore, the observations for category 20 are used for the November 1998 to December 2000 period. For the January 2001 to September 2008 period, the observations for 20A, 20B, and 20C have been added up. That is, the four categories have been integrated into one category, thereby using the original labelling 'Line Pipe' in the analysis.

51 The series is constantly updated and revised.

52 The crude oil price dataset is published in nominal U.S. Dollars and needs to be adjusted for inflation (EIA 2011f). The dataset has been deflated by using the U.S. Consumer Price Index (CPI). The CPI is the most widely used measure of inflation (U.S. Bureau of Labor Statistics 2001) and is also used as a deflator in publications with similar content (for

example Beverelli 2010). Data and information on the CPI are published on the website of the U.S. Bureau of Labor Statistics, http://www.bls.gov/CPI.

53 The G5 release contains exchange rates for the U.S. and Australia, Brazil, Canada, China, Mexico, Japan, Denmark, the Eurozone members, Hong Kong, India, Malaysia, New Zealand, Norway, Singapore, South Africa, South Korea, Sweden, Switzerland, Taiwan, Thailand, the United Kingdom, and Venezuela.

54 The bilateral exchange rates between the U.S. and the following countries have been collected from the OECD's dataset: Australia, Austria, Belgium, China, Finland, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, New Zealand, Portugal, Spain, and the United Kingdom.

55 The "fxAverage (Foreign Exchange Rate Converter) is a multilingual currency exchange converter that calculates weekly, monthly, quarterly, or yearly average exchange rates for any user-specified time horizon." (OANDA n.d.a)

56 The bilateral exchange rates between the U.S. and the following countries have been collected from the OANDA currency conversion system: Algeria, Argentina, Bulgaria, Chile, Colombia, Costa Rica, Czech Republic, Dominican Republic, Ecuador, Egypt, El Salvador, Estonia, Guatemala, Honduras, Hungary, Indonesia, Israel, Kazakhstan, Latvia, Lithuania, Panama, Peru, Philippines, Poland, Romania, Russia, Saudi Arabia, Slovakia, Trinidad and Tobago, Turkey, Ukraine, United Arab Emirates, Uruguay.

57 For more information on the company and its products, the reader is referred to: E-forecasting.com, 65 Newmarket Road, Durham, New Hampshire, 03824, United States; Phone: 603.868.7436; email: info@e-forecasting.com; homepage: www.e-forecasting.com.

58 The series is constantly updated and revised.

59 The problem of spurious regressions is especially evident in macroeconomics. Consequently, the macroeconomic literature provides a good number of articles dealing with unit root testing, see e.g. Nelson and Plosser (1982) and Campbell and Mankiw (1987).

60 The ADF exists in three variations designed to take into account the role of the constant term and the trend. Hence, before carrying out the ADF test, a useful first step is to plot the time series to be tested to determine which of the above listed variants of the test is suitable by inspecting the plot. ADF test 1 (no constant and no trend) should be used when the series seems to be wandering or fluctuating around a sample average of zero. ADF test 2 (with constant but no trend) should be used when the series seems to be wandering or fluctuating around a non-zero average. ADF test 3 (with constant and with trend) should be used when the series seems to be wandering or fluctuating around a linear trend.

61 Following this premise, the maximal lag length that can be used is calculated as follows: the number of lags included should not exceed $mp + 1 < T$ where

m = number of endogenous variables (used in this study: 5)
p = maximal lag length (?)
T = total number of observations (119)

Hence, $5p + 1 < 119$ or $p = 118/5 = 23{,}6$ => maximal lag length: 23

62 According to Lütkepohl (2004), strictly applying the AIC may lead to the inclusion of too many lags.

63 Alternatively, other testing procedures such as the Portmanteau test can also be applied to test for autocorrelation in the residuals. For a detailed discussion about exercisable autocorrelation testing procedures, the reader is referred to Lütkepohl (2004: 127-131).

64 The econometric output for this study is produced in EViews. However, due to the fact that error bands for VEC model cannot be produced in EViews, GRETL is used for error band production. According to Cottrell and Lucchetti (2012: 208), "following common practice among econometric software, gretl computes the confidence intervals by using the bootstrap."

65 For a more in-depth discussion on Monte Carlo sampling methods the reader is referred to Mooney (1997).

66 For more details of the Wishart distribution see Zellner (1971).

67 The analysis of steel exports to the U.S. by steel product category in section 6.4 has been extended by the identification of price patterns. The anytical approach used for the analysis in section 6.4 is described in sub-section 6.4.1

68 The estimated coking coal trade distances only have exemplary character and other ports of departure and destination also might have been selected.

69 The distances estimated by using the port distance calculator (vesseltracker) have been controlled on a spot-check basis by using another port distance calculator (PortWorld n.d.). No significant differences between the estimates could be detected.

70 However, it needs to be mentioned that the status for some countries (net importer or exporter) could not be determined due to a lack of data.

71 Mirza and Zitouna (2008) find that the economic size of exporting countries positively affects exports volumes to the United States.

72 Steel, iron ore, and coking coal are almost always shipped in Bulk. The bulk trade consists to a large extent of high-volume and price-sensitive cargo. Because the focus is on low-cost transport, the bulk transport industry usually ships large parcels of raw materials and semi-manufactures (Stopford 2009: 63f., 78, 590). An important criterion for bulk carriers is size. Generally, they are broken down into the following categories: Handy bulk carriers (10,000-40,000dwt) and Handymax bulk carriers (40,000-60,000dwt) usually carry minor bulks and small parcels of major bulks. Panamax bulk carriers (60,000-100,000dwt) primarily carry major bulks as well as large minor bulk parcels. Capesize bulk carriers (100,000-300,000dwt) serve the upper end of the bulk market and are used for the iron ore and coal trades (Stopford 2009: 591f.). The average size of bulk carriers is a dominant feature and has constantly increased over time. This is an indicator for the growing importance of economies of scale in the bulk shipping market (Lundgren 1996; Rodrigue and Browne 2008: 177). While small vessels are flexible but expensive to operate, large ships are rather inflexible and become progressively cheaper (Stopford 2009: 592), thus making them attractive for low-value commodity transport.In 2002 the average shipping size of steel billets was 24,650 tons and the average shipping size for steel pipes was 22,750 tons (Stopford 2009: 421). Moreover, in 2001/2002, the average size of coking coal shipments was 43,257 tons compared with 147,804 tons for iron ore (Stopford 2009: 421).

73 The two main criteria for determining the stage of development are GDP per capita (stage 1: < \$2,000; transition from stage 1 to 2: \$2,000-3,000; stage 2: \$3,000-9,000; transition

from stage 2 to 3: $9,000-17,000; stage 3: > $17,000) and the extent to which countries are factor driven (Schwab and Porter 2008).

74 When a country is in the transition process from a factor-driven to an efficiency-driven economy, this is indicated by 'transition 1-2'. If a country is in the transition process from an efficiency-driven to an innovation-driven economy, this is indicated by 'transition 2-3'.

75 Wages (or hourly pay for time worked) include the following cost components: basic wages, piece rate, (overtime, shift, holiday, night) premiums, cost-of-living adjustments and bonuses and premiums paid each pay period (U.S. Bureau of Labor Statistics 2011).

76 The BLS defines hourly compensation costs as follows: "Hourly compensation costs include (1) hourly direct pay and (2) employer social insurance expenditures and other labor taxes." (U.S. Department of Labor 2009)

77 The manufacturing sector includes the subsectors primary metal manufacturing and fabricated metal product manufacturing (U.S. Bureau of Labor Statistics n.d.).

78 A definition of the primary metal manufacturing (NAICS 331) sector can be found in: U.S. Census n.d.a. The iron and steel mills (NAICS 331111) and the product manufacturing from purchased steel (NAICS 3312) sectors, which are sub-sectors of the primary steel manufacturing sector, are defined in: U.S. Census n.d.b. and U.S. Census 2011c.

79 A definition of the fabricated metal product manufacturing (NAICS 332) sector can be found in: U.S. Census 2011b.

80 This practise is also used in sections 6.2.2 – 6.2.9 and in section 6.4.

81 In some cases, it is not possible to determine whether a country is a net coking coal importer or exporter due to a lack of data availability.

82 Figures on iron ore imports and exports are only available for Belgium and Luxembourg combined.

83 When multiple bilateral trade distances have been calculated (e.g. for coking coal export ports/steel import ports in the U.S.), the shortest bilateral trade distance is chosen for the analysis because it can be assumed that bilateral trade volumes are largest for the shortest trade routes.

84 Mirza and Zitouna (2009) find that common language positively affects the probability to export.

85 U.S. coking coal exports grew by 24.5% in 2007 and by 34% in 2008 (UNCTAD 2008, 2009).

86 The U.S. steel industry imports iron ore mainly from comparatively nearby Brazil (7mt out of 8mt in 2004) and also has easy access to iron ore from neighbouring Canada. Moreover, the U.S. itself are a net exporter of iron ore. China, on the other hand, is the largest net importer of iron ore. China imports iron ore from Australia (70mt in 2004) and India (40mt), but also from relatively distant Brazil (54mt), Pacific South America (6mt), North America (2mt), South Africa (17mt) and Scandinavia (1mt) (Stopford 2009: 449). Therefore, the U.S. steel industry has a comparative advantage in terms of resource abundance and/or upstream ocean transport costs for iron ore imports over the Chinese steel industry. Due to the fact that most parts of China and East Asia are short of high-grade iron ore deposits, transporting the raw material to the steel mills (mainly from Australia and

Brazil) adds additional upstream trade costs not typically incurred by U.S. steel producers (Rubin and Tal 2008). China is the biggest importer of iron ore.

87 China`s comparative disadvantage can be shown by using the example of iron ore imports. According to UNCTAD (2008: 77), "with longer voyage times from China-Brazil than China-Australia, more Capesize tonnage is tied up going this route, thus further driving up the transport costs. A roundtrip voyage between Brazil and China takes on average about 74 days compared with a roundtrip voyage from Australia to China, which takes about 30 days. A 170000 dwt Capesize requires 0.59 vessels to carry 1 million metric tons/year from Australia to China, compared to 1.27 vessels for Brazil. Theoretically, this means that one Capesize vessel can make either five return trips from Brazil to China in one year against 12 return trips from Australia to China." Additionally, iron ore vessels usually do not return in ballast, thereby consuming valuable sailing time on longer voyages during which no revenue is earned (UNCTAD 2009). In 2008, Australian iron ore mining companies took advantage of the relative proximity of their resources to China by enforcing an extra charge reflecting Chinese freight savings (UNCTAD 2009). Therefore, the Chinese steel industry was punished twice when compared to the U.S. steel industry due to its relative remoteness from global iron ore producers.

88 The United States have been excluded for obvious reasons.

89 Multiple synonyms for vertical specialisation are used in the trade literature, for example slicing up the value chain (Krugman 1995), delocalisation (Leamer 1998), outsourcing (Bourguignon et al. 2002), trade in tasks, off-shoring (Grossman and Rossi-Hansberg 2008), international product fragmentation (Deardorff 1998; Jones and Kierzkowski 2001), vertical disintegration of production (Feenstra 1998; Bird and Rajan 2001), multi-stage production (Dixit and Grossman 1982), intra-product specialisation (Hummels et al. 2001), super-specialisation (Arndt: 1996 1998), trans-world production process (Scholte 2005: 107), Heckscher-Ohlin plus production fragmentation (Knetter and Slaughter 2000), and intra-product trade (Jones et al. 2005).

90 Vertical specialisation can be illustrated by using the example of Chinese steel production: First, intermediate goods such as coking coal (e.g. from Australia) and iron ore (e.g. from Australia, Brazil) are imported from other countries (= country 1). Second, the intermediate goods are used in China (= country 2) to produce steel. Domestic intermediate goods also contribute to steel production as well as Chinese capital and labour. Third, while the produced raw steel is in part sold domestically, a significant part of Chinese steel production is also exported to other countries such as the United States (= country 3).

91 According to Krugman (1995: 334), "in 1913, a given consumer good could, to a rough approximation, be exported only once. Today it can be exported many times: a good that is produced in one country may be assembled from subcomponents produced in yet other countries. As a result, the trade involved in the global production of a final good may easily be several times the value added in all stages of that production."

92 This trend can be illustrated by using the example of ocean trade. Demand for ocean transport services can be expressed most adequately in ton-miles because ton-miles reflect the development of cargo volumes *and* the distances travelled as well as the geographical distribution of suppliers and customers. The trend to a growth in ton-miles reflects the so called 'new geography of trade' which includes the trend towards vertical specialisation.Between 2006 and 2008, ton-miles growth rates declined significantly in a number of categories parallel to rapidly increasing crude oil prices. World seaborne trade ton-mile growth rates declined from 5.9% in 2006 to 4.5% in 2007 and to 4.2% in 2008. A similar trend can be observed for the five main dry bulks (2006: 9.4%; 2007: 7.0%; 2008: 5.0%) and for coal trade (2006: 13.7%; 2007: 6.7%; 2008: 3.4%). The pattern for iron ore is

less clear (2006: 7.0%; 2007: 8.4%; 2008: 6.7%) but a slight downward-trend can be observed when comparing the growth rates for 2006 and 2008 (UNCTAD 2009).

93 Bardi et al. (2006: 20) describe the concept of vertical specialisation based on comparative advantage as follows: “The concept of geographical specialization assumes that each nation … produces products and services for which its capital, labor, and raw materials are best suited. Because any one area can’t produce all needed goods, transportation is needed to send the goods that might be most efficiently produced at point A to point B in return for different goods efficiently produced at point B. The concept is closely aligned to the principle of comparative advantage.”

94 For this reason, labour costs (manufacturing wages, compensation costs in the primary metal manufacturing and fabricated product manufacturing sectors) have been used as evaluation criteria in the analysis of the econometric estimates in chapter 6.

95 China is the most important of those low-wage manufacturing platforms. Dean et al. (2007) measure the extent of vertical specialisation in the Chinese economy. They point out that two interconnected developments have shaped the nature of international trade in recent years. The first of these trends are explosive Chinese trade growth rates, the second is increasing vertical specialisation. Although the literature on both trends is large, few papers quantitatively assess these two trends together. Dean et al. (2007) find that the aggregate import content (the relative share of vertical specialisation) of Chinese exports was 29.3% in 1997 and grew to 35.9% in 2002. Therefore, the vertical specialisation of the Chinese economy seems to increase over time. Moreover, intermediate goods accounted for about one third of China’s total exports in 2003, and made up nearly 40% of China’s export growth during the 1992-2003 period (Athukorala 2006; Athukorala and Yamashita 2006). Finally, China’s exports to the U.S. also contain a growing share of imported intermediate goods (Dean et al. 2007).When it comes to the extent of vertical specialisation in the Chinese steel industry, the value of imported inputs in the value of exports for the steel processing industry was 59% in 1997 and already 69% in 2002.

96 For example, Koopman et al. (2008) find that only 18% of the Chinese processing export value is actually added in China while 82% consists of the value of imported intermediate inputs.

97 For example, in the mid-2000s Scholte (2005: 68) stated that “differences in local costs of labour, raw materials, regulation and taxation often figure more importantly in … business calculations than the costs of transport across territorial distance and borders between the various sites in the global production chain.”

98 The East Asian Trade Model may be at risk (Gangnes et al. 2011a; Jen and Bindelli 2008).

99 The low value-to-weight ratio of those commodities is even more important than the value-to-volume ratio. Hummels (1999b; 2007a; b) estimates an elasticity of maritime transport costs to weight/value of 0.41. He points out that besides factors such as the distance of trade or the quality of the transport service offered, the value-to-weight ratio of a commodity is an essential determinant of ad valorem transport costs for a particular product. Thereby, ocean shipping drives a particularly large wedge between the prices at the origin and destination for commodities with a very low value per ton (Hummels 2009). Hummels and Lugovskyy (2006) also emphasise that transportation costs are highly correlated with the weight/value of a shipment. Rubin and Tal (2008) analyse the impact of rising transport cost levels on trade between China and the United States. They report that a high percentage of Chinese exports to the U.S. (for example furniture, apparel, footwear, metal manufacturing and small industrial machinery) have a low value-to-freight ratio and therefore incur high

transportation costs relative to final selling prices. Parallel to a general slowdown in Chinese-U.S. export growth figures, the slowdown was significantly more pronounced for goods with a relatively high share of transport costs to final selling prices. In May 2008, freight-sensitive Chinese exports to the U.S. accounted for 42% of total exports compared to 52% in 2004. Rubin and Tal estimate that export figures from China to the U.S. would have been higher by 30% for the 2004-2008 period if transport costs would not have increased substantially.

100 According to Rodrik (2000: 181), a perfectly integrated global economy "would be a world economy in which national jurisdictions do not interfere with arbitrage in markets for goods, services or capital. Transaction costs and tax differentials would be minor; convergence in commodity prices and factor returns would be almost complete."

101 The majority of international trade flows has a regional connotation due to proximity and economic blocks such as NAFTA or the European Union. The likelihood of economic entities to trade with each other increases with proximity (Rodrigue 2009). This phenomenon is also referred to as the neighbourhood effect (Rohter 2008).

102 Rugman et al. (2009) aim to determine whether the supply chains of North American companies are regional or global. In order to find out where North American MNCs perform the majority of their upstream and downstream activities, the authors analyse the supply chains of the 183 North American companies (16 Canadian, 5 Mexican, 162 U.S. firms) listed in the 2006 Fortune Global 500 ranking of the world's 500 largest firms. They find that 85% or 155 of the 183 companies have regional supply chains. Thereby, 91% of the upstream supply chains analysed (global: 3%) and 87% of the downstream supply chains analysed (global: 1%) are regional. The empirical evidence indicates that the supply chains of the majority of North American companies are regional, not global.

103 Exemplarily, Krugman (1995: 330) stresses that "it is a late twentieth-century conceit that we invented the global economy just yesterday."

104 Chase-Dunn et al. (2000) identify three (1815-1879, 1903-1924, 1946-present) instead of two waves.

105 According to O'Rourke and Williamson (1999: 167), "the middle ages were ones of de-globalization and divergence."

106 In the most influential contribution to the literature about the first wave of globalisation (Jacks et al. 2006), O'Rourke and Williamson (1999: 35) describe this transport revolution as follows: "The decline in international transport costs after mid-century was enormous, and it ushered a new era. When economists look at this period, they tend to ignore this fact and focus instead on tariffs and trade. This is a mistake. It turns out that tariffs in the Atlantic economy did *not* fall from the 1870s to World War I; the globalization that took place in the nineteenth century cannot be ascribed to more liberal trade policy. Instead, it was falling transport costs that provoked globalization. Indeed, rising tariffs were mainly a defensive response to the competitive winds of market integration as transport costs declined."

107 According to Estevadeordal et al. (2003: 362), transportation costs on maritime routes "fell dramatically before 1914, as is well known, but they then rose steeply up to 1939 – a lesser known fact."

108 Before that, transport costs rose sharply during the 1914-1945 period (Estevadeordal et al. 2003).

109 John Maynard Keynes (1919: 9f.) famously bemoans the end of the first wave of globalisation in his publication ‘The Economic Consequences of the Peace’: “What an extraordinary episode in the economic progress of man that age was which came to an end in August 1914! … The inhabitant of London could order by telephone, sipping his morning tea in bed, the various products of the whole earth, in such quantity as he might see fit, and reasonably expect their early delivery upon his doorstep; he could at the same moment and by the same means adventure his wealth in the natural resources and new enterprises of any quarter of the world, and share, without exertion or even trouble, in their prospective fruits and advantages; or he could decide to couple the security of his fortunes with the good faith of the townspeople of any municipality in any continent that fancy or information might recommend. He could secure forthwith, if he wished it, cheap and comfortable means of transit to any country or climate without passport or other formality, could despatch his servant to the neighbouring office of a bank for such supply of the precious metals as might seem convenient, and could then proceed abroad to foreign quarters, without knowledge of their religion, language, or customs, bearing coined wealth upon his person, and would consider himself greatly aggrieved and much surprised at the least interference. But, most important of all, he regarded this state of affairs as normal, certain, and permanent, except in the direction of further improvement, and any deviation from it as aberrant, scandalous and avoidable.”

110 According to Jacks et al. (2008a), international trade costs on average increased by 18% during the 1929-1932 period alone.

111 Other experts also weigh in on this issue. For example, James (2002: 1) remarks that “often we believe that this [globalisation] is irreversible, that it provides a one-way road to the future. But historical reflections lead to a more sober and more pessimistic assessment. There have already been highly developed and highly integrated international communities that dissolved under the pressure of unexpected events. But in every case the momentum was lost: the pendulum swung back.” And Abdelal and Segal (2007: 103) refer to “historians such as Niall Ferguson and Harold James [who have] pointed out that the previous era of globalization (which ran from about 1870 to 1914) had once seemed as unstoppable as the current one but had ended disastrously.”

112 As Scholte (2005: 86) puts it, “although recent decades of globalization have shown progressive acceleration, the trend is not inherently linear.”

113 Beverelli (2010: 1) describes the situation in the ocean transport sector as follows: “Like other modes, maritime transport relies heavily on oil for propulsion and, in view of limitations imposed by existing technology and costs, is not yet in a position to adopt effective energy substitutes (e.g. biofuels, solar and wind). At the same time, fossil fuel reserves are finite, oil extraction is becoming increasingly costly and oil production overall is believed to either already have peaked or to reach its maximum level soon. The dependency of the maritime transport sector on a source of energy that is becoming increasingly scarce and more costly to produce, compounded by limited prospects, at least in the short term, for using alternative energy may entail some serious implications for the cost of maritime transport services. With over 80 per cent of global merchandise trade being carried by sea, the question of how changes in oil prices affect ocean shipping rates is of considerable relevance.”

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The Impact of Peak Oil on Globalisation – An Example of Steel Exports to the United States
- Appendix -

Thesis submitted in accordance with the requirements of the University of Liverpool for the degree of Doctor in Philosophy

by

Jan Moldenhauer

April 2013

Appendix: Table of Contents

1 Mathematical Derivation of Peak Oil

Martin King Hubbert used the following mathematical derivation to calculate peak oil production (Cavallo 2005; Stieler 2006):

[A1.1] $Q(t) = Q_{max} / (1+ a \exp bt)$

Alternative one : $Q(t) = Q_{max} / 1+ a^{bt}$

Alternative two : $Q(t) = Q_{tot} b \exp(-b(t-t_0)) / (1 + \exp(-b(t-t_0))^2$

Variables :

$Q(t)$ = cumulative production

$Q_{max} = Q_{tot}$ = total resource available or ultimate recovery of crude oil

a and b = constants

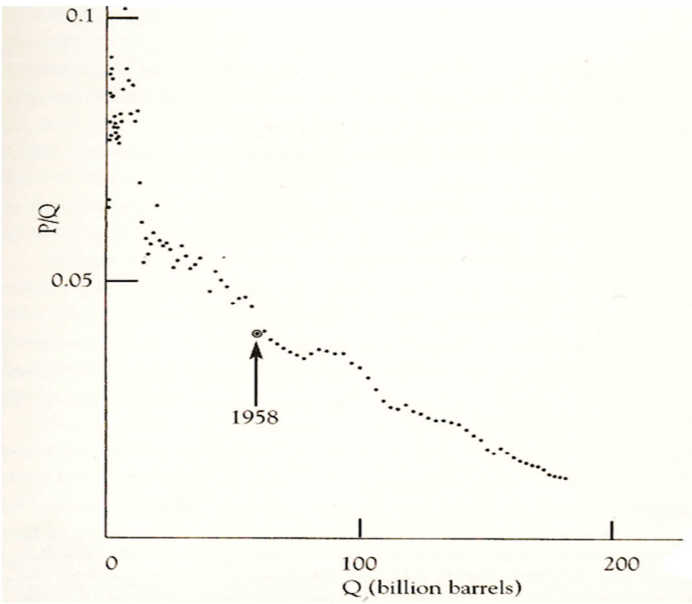
Crude oil production (the first derivative of [A1.1]) begins slowly, then grows exponentially, reaches a maximum, and then declines. The characteristics of this equation are its symmetry about the point of maximum annual production and the identical increase and decrease of annual production. The maximum annual production is given by:

[A1.2] $P_{max} = Q_{max} |b| / 4$,

The year of maximum annual production is given by:

$t_{max} = (1/b) \text{ 1n } (1/a)$

Figure A1.1 Hubbert's Diagram of Oil Production



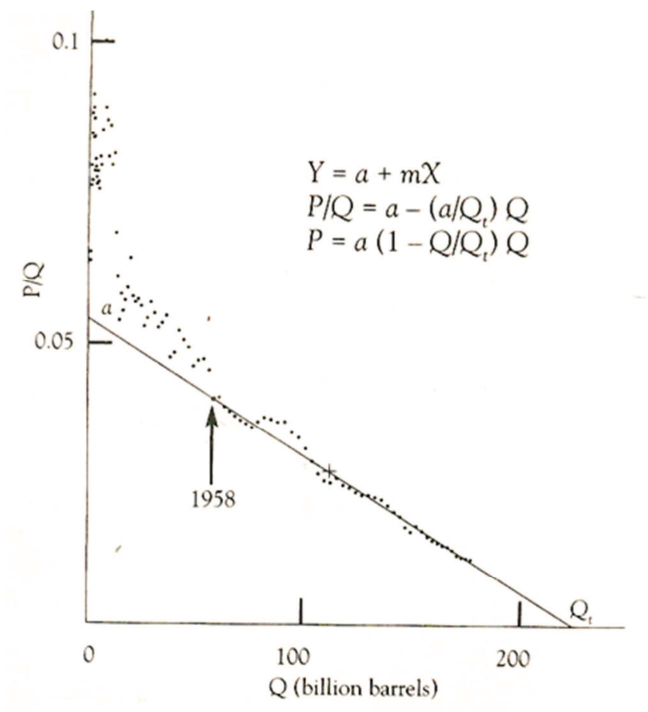
Source: Deffeyes 2005: 37

An alternative to Hubbert's calculation of peak oil is described below by using the example of U.S. oil production: In its original form, Hubbert's calculation involves serious mathematics, a circumstance that raised suspicions among experts he may be hiding something behind this mathematical curtain. By not publishing his reasons for choosing specific formulas until 1982, Hubbert partly contributed to the confusion. In his publication 'Beyond Oil', Kenneth Deffeyes, a former colleague, provides a simplified alternative derivation, thereby obtaining results that are identical with those of Hubbert.

Like Hubbert, Deffeyes chooses the historical development of U.S. oil production as a data set for testing. In order to present his derivation graphically, Deffeyes picks a coordinate system in which the horizontal axis plots the cumulative oil production Q and the vertical axis represents the ratio of annual production to cumulative production (P/Q) (see figure A1.1). P stands for annual oil production and Q stands for cumulative oil production (from 1859 to a particular year). The points in the upper left of the graph are a result of low cumulative oil production (in the denominator).

The straight line (= best fits the data from 1958 to 2003 in the previous graph) in figure A1.2 meets the horizontal axis at 228 billion barrels. However, this number only shows the momentary position of the straight line as it represents Hubbert's expected amount of produced oil within the U.S. when the last drop of oil has been pumped (Q_t = cumulative total). The intercept of the straight line with the virtual axis (*a*) expresses the annual oil production as a fraction of cumulative production. It can be regarded as an idealised beginning when cumulative crude oil production in the U.S. was zero.

Figure A1. 2 Mathematical Graph of Oil Production



Source: Deffeyes 2005: 38

For the U.S., the vertical intercept for *a* is 0.0536 which equals 5.36% per year. Hubbert's entire theory is reflected by that line. In fact, that line *is* Hubbert's Law. At this stage, three additional equations come into play:

[A1.3] $Y = a + mX$

[A1.4] $P/Q = a - (a/Q_t)\, Q$

[A1.5] $P = a\,(1 - Q/Q_t)\, Q$

Equation [A1.3] is the mathematical equation of a straight line in a coordinate system:

Y = the vertical axis of the graph

X = the horizontal axis

a = the value of Y when X is zero

m = the slope of the line

Equation [A1.4] can be regarded as a translation in which the symbols of the graph are set:

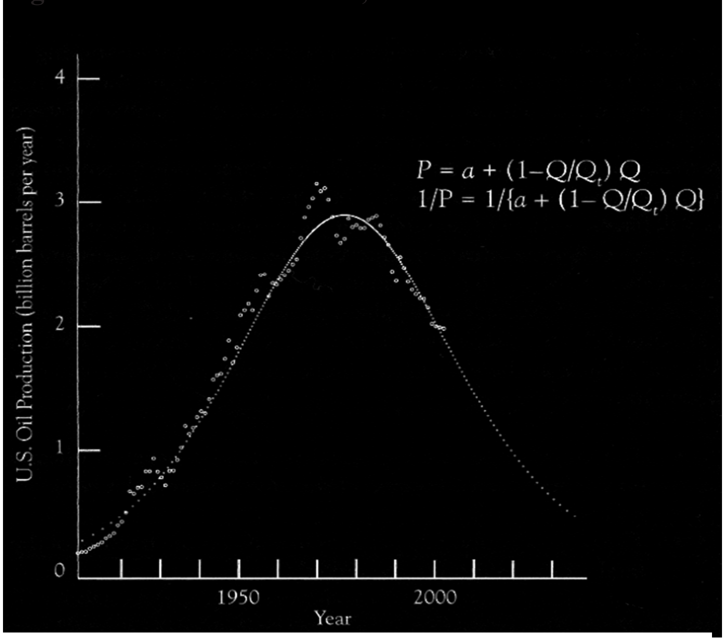
- Y becomes P/Q
- X is Q
- *a* keeps the same meaning
- *m* is - a/Q_t
- the minus sign arises because Y decreases as X increases

Equation [A1.5] describes a bell-shaped curve and can be obtained by multiplying both sides of equation [A1.4] with Q. As mentioned previously, the peak of oil production which is indicated within the graph by a + (see figure A1.2), occurs when half of the oil has been pumped. The essential part of the theory can be found inside the parentheses of equation [A1.5]: $(1 – Q/Q_t)$:

When Q/Q_t is the fraction of the total oil which has already been produced, $(1 – Q/Q_t)$ is the fraction yet to be produced.

Equation [A1.5] indicates that the ability to produce oil (P) is linearly dependent on the fraction of oil that is yet to be extracted. At the beginning of oil production (in the United States) Q was 0 and the term inside the parentheses equaled 1, whereas at the very end of crude oil production, Q and Q_t become equal and $(1 – Q/Q_t)$: 1 – 1 = 0. Between those two neuralgic points, Q slides down the straight line from 0 to 1 (see figure A1.2).

Figure A1. 3 Oil Production , Hubbert Curve



Source: Deffeyes 2005: 41

In the end, the whole debate between the supporters and critics of Hubbert's Law comes down to what is inside these parentheses.

In order to get to the bell-shaped curve shown in figure A1.3, another equation is needed:

$P = a + (1 - Q/Q_t)\,Q$ [A1.6]

$1/P = 1/(a + (1 - Q/Q_t)\,Q)$ [A1.7]

Equation [A1.7] is the reciprocal of equation [A1.6]. In other words, by dividing 1 by both sides of [A1.6], one gets [A1.7], which now expresses years per billion barrels instead of billion barrels per year. Each dot in figure A1.3 stands for one billion barrels of production, thereby corresponding to the ideal straight line (for the U.S.) in figure A1.2. For every billion barrel of cumulative U.S. production (Q), *a* (0.0536) and Q_t (228.4 billion barrels) are used to compute a time interval (1/P). The single time intervals are then summed up to get the total time-span of oil production. The resulting graph is the bell-shaped curve shown in figure A1.3.

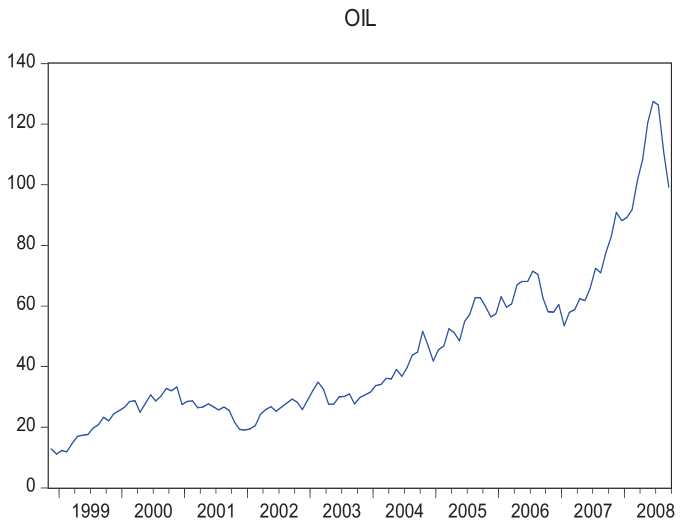
Given that the bell-shaped curve or rather logistic curve is symmetrical in time, its downside mirrors its upside (This is of course an ideal-type scenario.) which is a consequence of the production rate's linear dependence on the unproduced fraction.

The area below the logistic curve is Q_t. As a result of the symmetry in time, the peak year occurs when the area below the curve reaches half of $Q_{t.}$ The maximum extraction during the year in which the midpoint is reached is $0.25aQ_t$. If Hubbert's law is applied to calculate the peak of global oil production, world oil production swings into the straight line in 1983. Deffeyes uses 2 trillion barrels of oil as the final amount of produced oil (Q_t) and an *a* intercept of 0.05, thereby calculating 2003 as the year in which daily oil production reaches its physical limit (see + in figure A1.3). However, there are numerous other estimates for Q_t and by putting in other figures, the results obtained are different (Deffeyes 2005:35ff.).

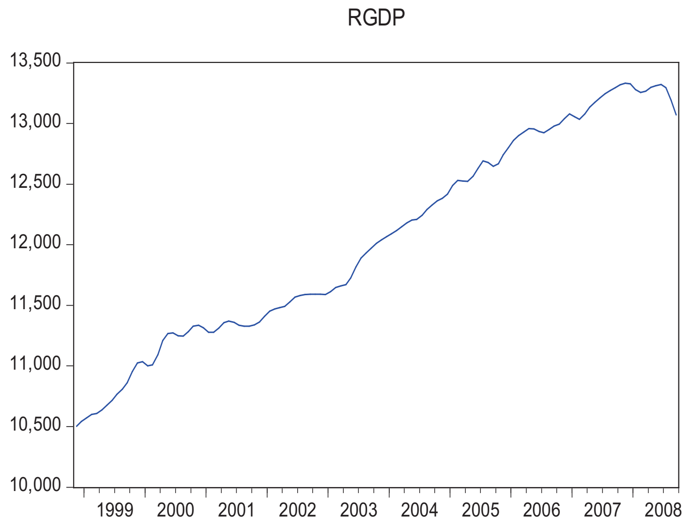
2 Graphical Display of Research Variables and Descriptive Statistics

Section 2 contains graphical displays and descriptive statistics for the research variables used in the econometric analysis.

2.1 Descriptive Statistics Real Oil Price (OIL) and U.S. Real GDP (RGDP)



Descriptive Statistics	
	OIL
Mean	44.553
Maximum	127.478
Minimum	11.170
Std. Dev.	25.917
Skewness	1.247
Kurtosis	4.134
Jarque-Bera	37.212
Sum	5,301.806
Sum Sq. Dev.	79,261.570
Observations	119



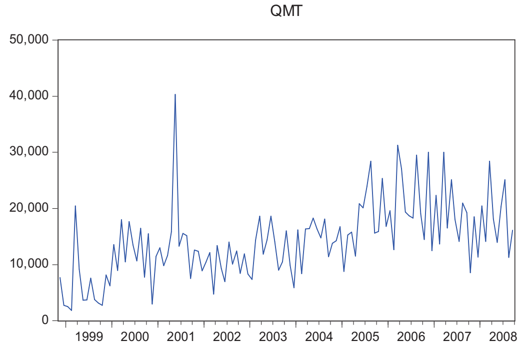
Descriptive Statistics	
	RGDP
Mean	12,043.670
Maximum	13,332.000
Minimum	10,501.000
Std. Dev.	858.974
Skewness	0.016
Kurtosis	1.701
Jarque-Bera	8.366
Sum	1,433,197.000
Sum Sq. Dev.	87,064,652.000
Observations	119

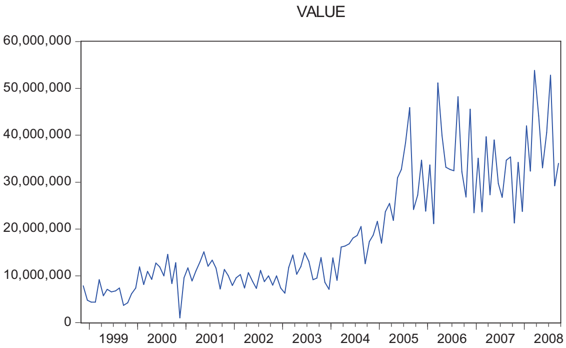
2.2 Graphical Display and Descriptive Statistics per Country – QMT, VALUE, EXRA

QMT = U.S. Steel Imports, VALUE = U.S. Steel Import Value, EXRA = Echange Rates, per exporting country.

2.2.1 European Union

2.2.1.1 Austria

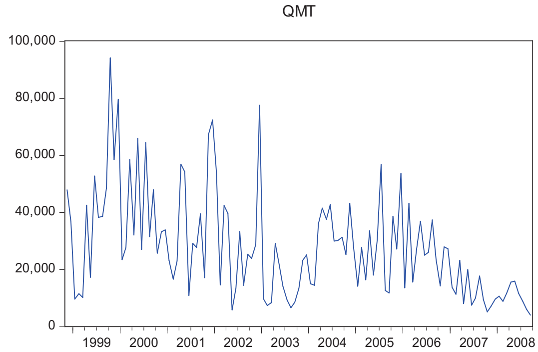


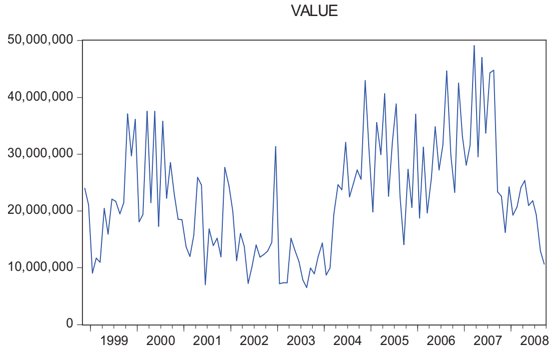


Descriptive Statistics - Austria

	EXRA	QMT	VALUE
Mean	0.893	14,431	19,155,038
Maximum	1.172	40,319	53,829,909
Minimum	0.635	1,839	1,022,289
Std. Dev.	0.151	6,849	12,773,280
Skewness	0.290	0.737	0.890
Kurtosis	1.960	4.159	2.772
Jarque-Bera	7.034	17.434	15.951
Sum	106.313	1,717,306	2.28E+09
Sum Sq. Dev.	2.682	5.54E+09	1.93E+16
Observations	119	119	119

2.2.1.2 Belgium

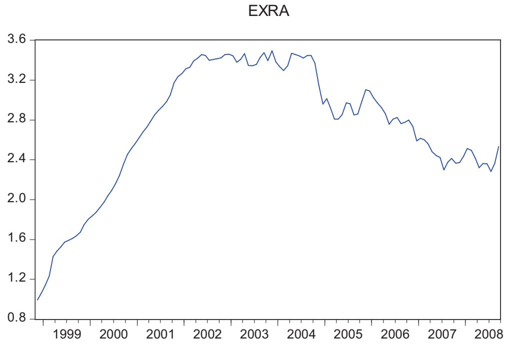


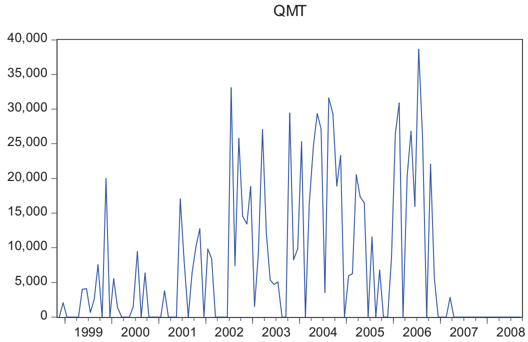


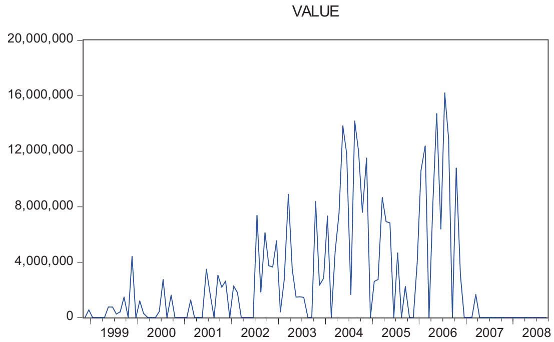
Descriptive Statistics - Belgium

	EXRA	QMT	VALUE
Mean	0.893	27,830	22,431,229
Maximum	1.172	94,264	49,109,313
Minimum	0.635	3,937	6,520,559
Std. Dev.	0.151	18,296	10,127,288
Skewness	0.290	1.115	0.545
Kurtosis	1.960	4.070	2.669
Jarque-Bera	7.034	30.335	6.431
Sum	106.313	3,311,810	2.67E+09
Sum Sq. Dev.	2.682	3.95E+10	1.21E+16
Observations	119	119	119

2.2.1.3 Bulgaria



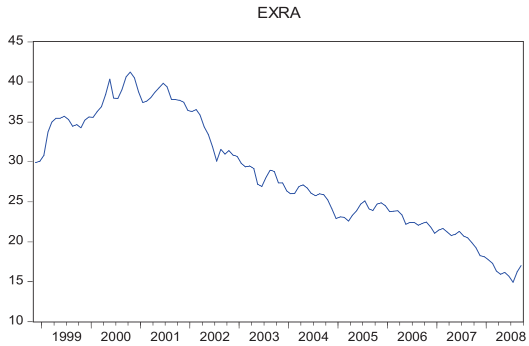


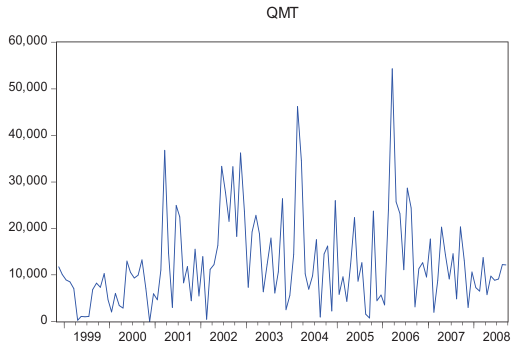


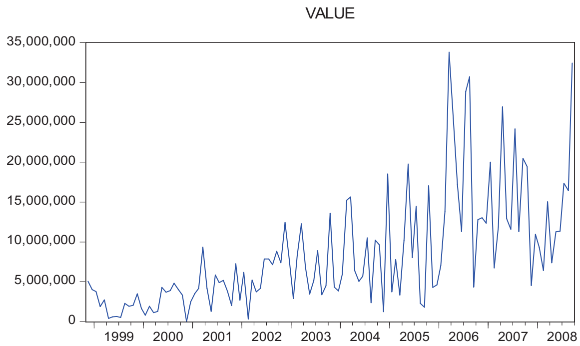
Descriptive Statistics - Bulgaria

	EXRA	QMT	VALUE
Mean	304.597	7,616	2,714,540
Maximum	1,905.800	38,629	16,204,374
Minimum	1.241	0	0
Std. Dev.	681.641	10,165	4,037,947
Skewness	1.820	1.210	1.625
Kurtosis	4.356	3.237	4.669
Jarque-Bera	74.801	29.295	66.186
Sum	36,246.980	906,345	3.23E+08
Sum Sq. Dev.	54,826,811.000	1.22E+10	1.92E+15
Observations	119	119	119

2.2.1.4 Czech Republic



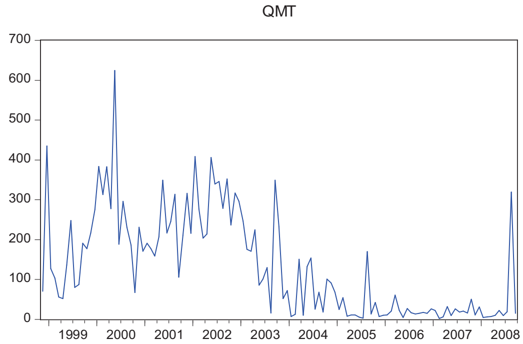


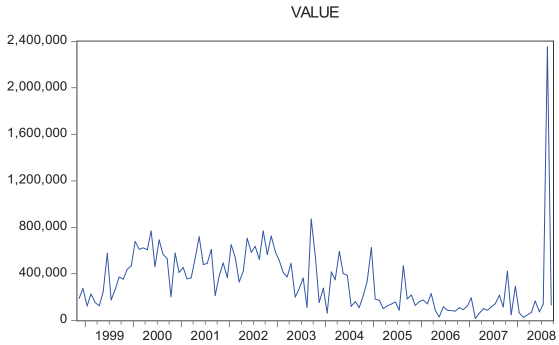


Descriptive Statistics - Czech Republic

	EXRA	QMT	VALUE
Mean	28.476	12,646	8,355,464
Maximum	41.229	54,298	33,791,675
Minimum	14.942	0	0
Std. Dev.	7.185	9,825	7,243,364
Skewness	0.058	1.449	1.499
Kurtosis	1.842	5.692	5.083
Jarque-Bera	6.718	77.580	66.097
Sum	3,388.688	1,504,910	9.94E+08
Sum Sq. Dev.	6,092.302	1.14E+10	6.19E+15
Observations	119	119	119

2.2.1.5 Denmark

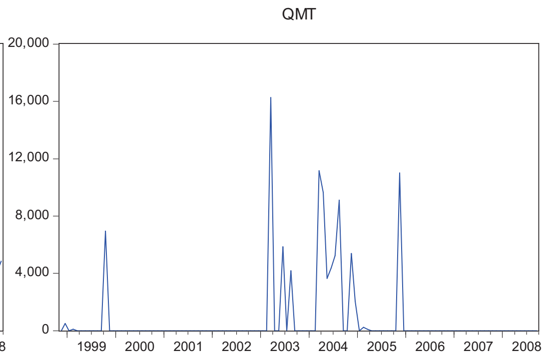


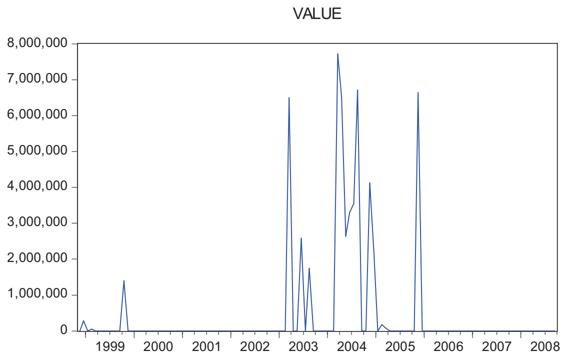


Descriptive Statistics - Denmark

	EXRA	QMT	VALUE
Mean	6.653	134	336,370
Maximum	8.740	624	2,353,103
Minimum	4.734	2	15,736
Std. Dev.	1.122	130	283,608
Skewness	0.300	0.943	3.172
Kurtosis	1.967	3.392	22.488
Jarque-Bera	7.068	18.390	2,082.623
Sum	791.722	15,953	40,028,006
Sum Sq. Dev.	148.634	2,005,925	9.49E+12
Observations	119	119	119

2.2.1.6 Estonia

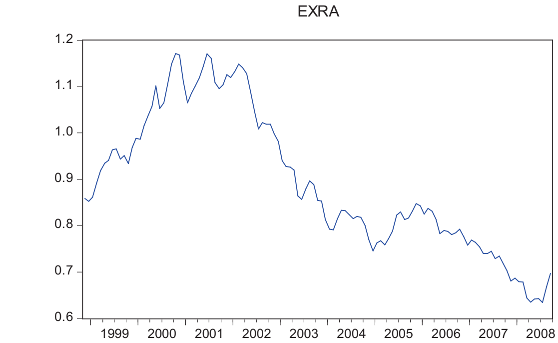


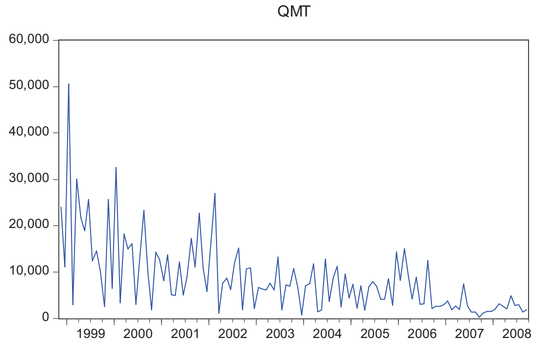


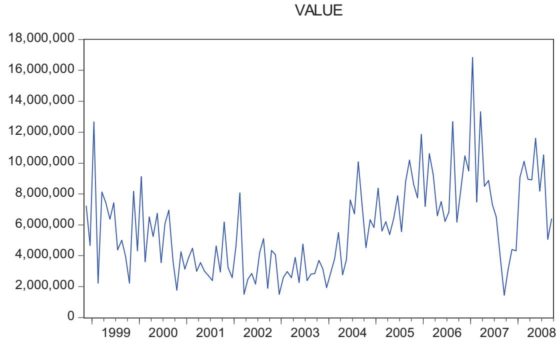
Descriptive Statistics - Estonia

	EXRA	QMT	VALUE
Mean	13.989	805	472,160
Maximum	18.329	16,258	7,716,958
Minimum	9.940	0	0
Std. Dev.	2.358	2,608	1,514,928
Skewness	0.292	3.706	3.461
Kurtosis	1.956	17.275	14.212
Jarque-Bera	7.097	1,282.864	860.937
Sum	1,664.647	95,826	56,187,080
Sum Sq. Dev.	655.915	8.03E+08	2.71E+14
Observations	119	119	119

2.2.1.7 Finland



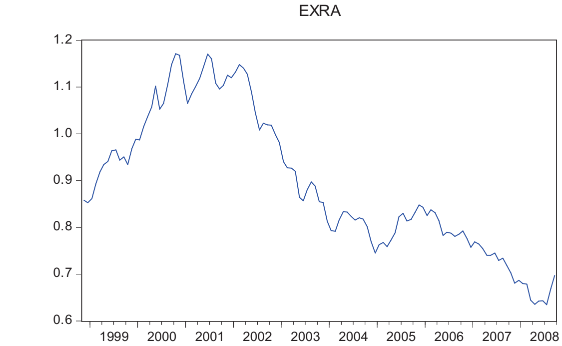


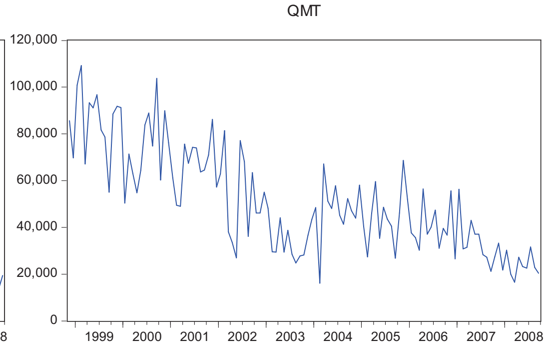


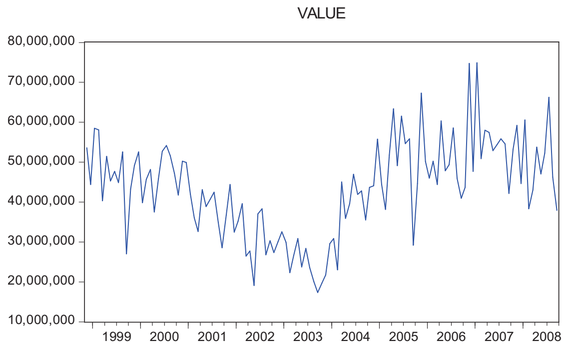
Descriptive Statistics - Finland

	EXRA	QMT	VALUE
Mean	0.893	8,658	5,816,721
Maximum	1.172	50,582	16,843,433
Minimum	0.635	257	1,448,245
Std. Dev.	0.151	7,868	2,978,210
Skewness	0.290	2.066	0.816
Kurtosis	1.960	9.373	3.585
Jarque-Bera	7.034	286.028	14.904
Sum	106.313	1,030,353	6.92E+08
Sum Sq. Dev.	2.682	7.30E+09	1.05E+15
Observations	119	119	119

2.2.1.8 France



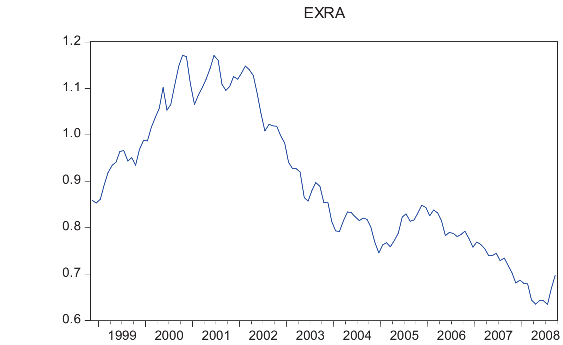


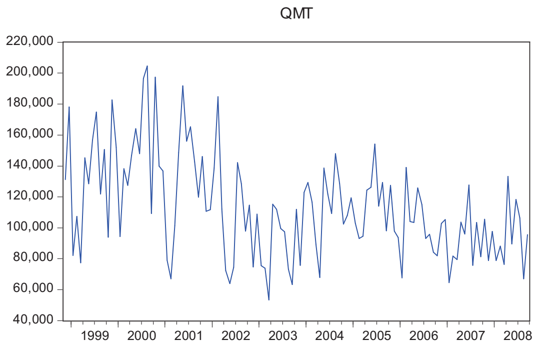


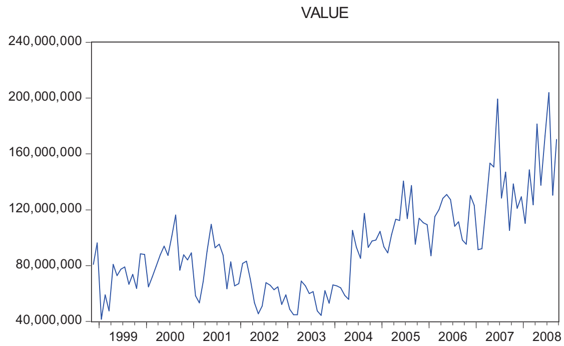
Descriptive Statistics - France

	EXRA	QMT	VALUE
Mean	0.893	51,384	43,348,653
Maximum	1.172	109,261	74,881,245
Minimum	0.635	16,164	17,368,092
Std. Dev.	0.151	22,249	11,959,236
Skewness	0.290	0.566	-0.014
Kurtosis	1.960	2.445	2.779
Jarque-Bera	7.034	7.891	0.247
Sum	106.313	6,114,699	5.16E+09
Sum Sq. Dev.	2.682	5.84E+10	1.69E+16
Observations	119	119	119

2.2.1.9 Germany



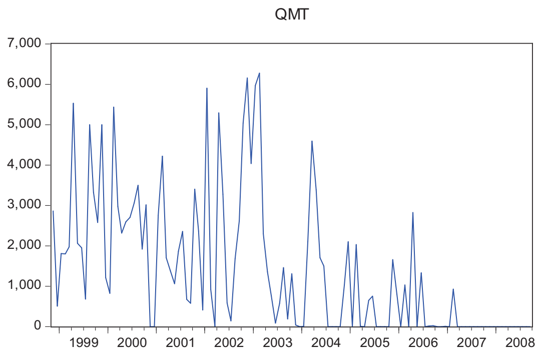


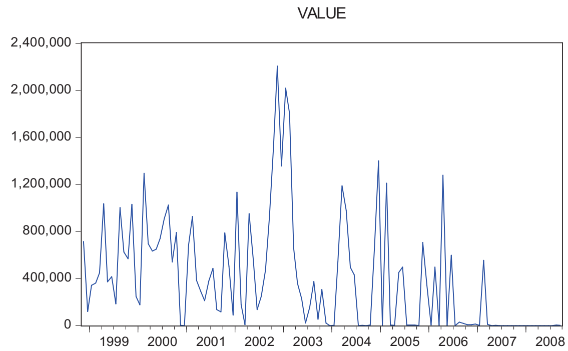


Descriptive Statistics - Germany

	EXRA	QMT	VALUE
Mean	0.893	113,608	93,415,145
Maximum	1.172	204,677	204,000,000
Minimum	0.635	53,552	41,605,227
Std. Dev.	0.151	32,772	33,845,523
Skewness	0.290	0.624	0.846
Kurtosis	1.960	3.018	3.667
Jarque-Bera	7.034	7.724	16.407
Sum	106.313	13,519,321	1.11E+10
Sum Sq. Dev.	2.682	1.27E+11	1.35E+17
Observations	119	119	119

2.2.1.10 Hungary

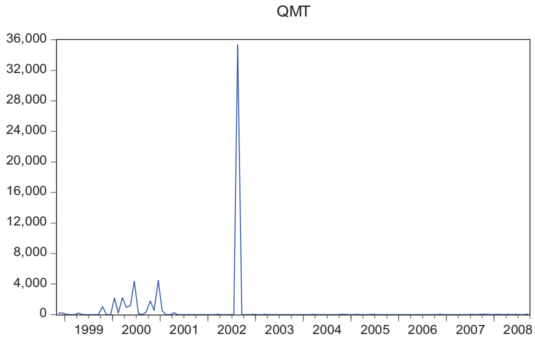


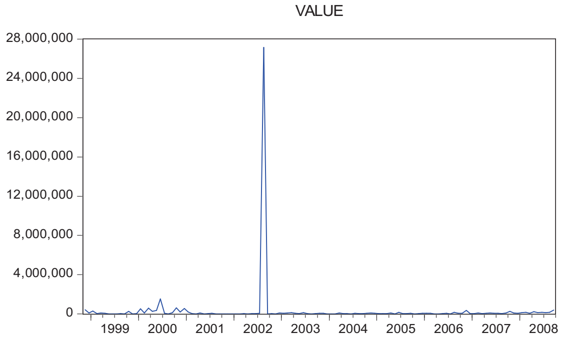


Descriptive Statistics - Hungary

	EXRA	QMT	VALUE
Mean	226.503	1,444	399,708
Maximum	309.181	6,276	2,206,033
Minimum	147.345	0	0
Std. Dev.	39.390	1,719	477,576
Skewness	0.303	1.187	1.404
Kurtosis	2.196	3.534	4.846
Jarque-Bera	5.033	29.343	56.026
Sum	26,953.880	171,799	47,565,214
Sum Sq. Dev.	183,089.200	3.49E+08	2.69E+13
Observations	119	119	119

2.2.1.11 Ireland

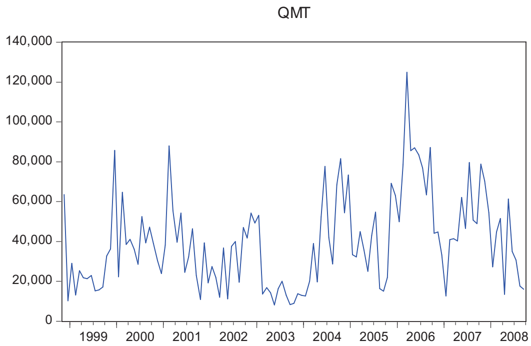


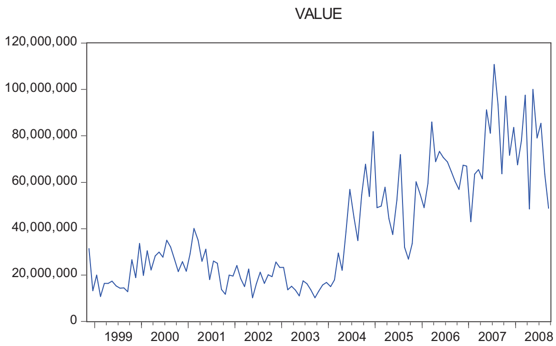


Descriptive Statistics - Ireland

	EXRA	QMT	VALUE
Mean	0.893	482	326,419
Maximum	1.172	35,348	27,162,172
Minimum	0.635	0	0
Std. Dev.	0.151	3,291	2,487,539
Skewness	0.290	10.148	10.685
Kurtosis	1.960	107.676	115.761
Jarque-Bera	7.034	56,370.940	65,309.320
Sum	106.313	57,301	38,843,802
Sum Sq. Dev.	2.682	1.28E+09	7.30E+14
Observations	119	119	119

2.2.1.12 Italy



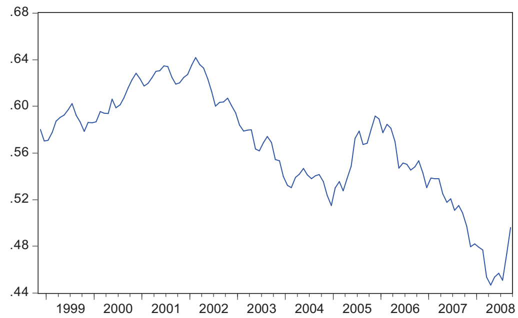


Descriptive Statistics - Italy

	EXRA	QMT	VALUE
Mean	0.893	39,919	40,027,844
Maximum	1.172	124,840	111,000,000
Minimum	0.635	8,156	10,157,350
Std. Dev.	0.151	23,071	25,441,511
Skewness	0.290	0.830	0.780
Kurtosis	1.960	3.443	2.514
Jarque-Bera	7.034	14.636	13.250
Sum	106.313	4,750,319	4.76E+09
Sum Sq. Dev.	2.682	6.28E+10	7.64E+16
Observations	119	119	119

2.2.1.13 Latvia

EXRA



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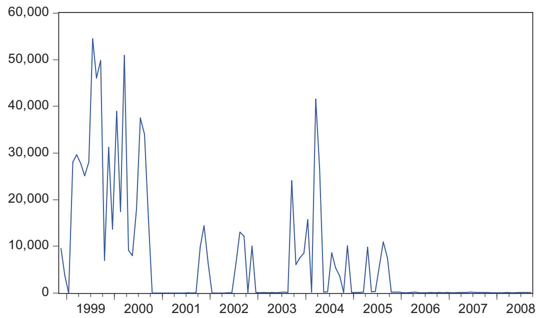

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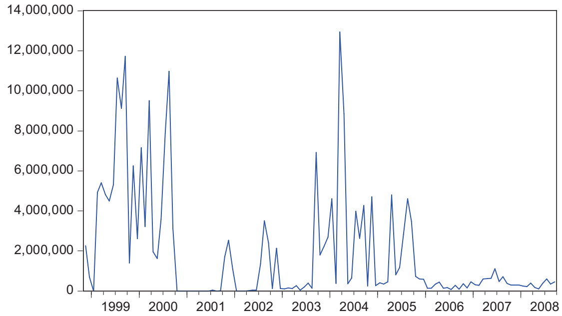
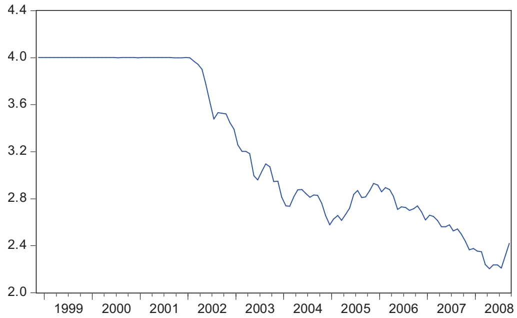


Descriptive Statistics - Latvia

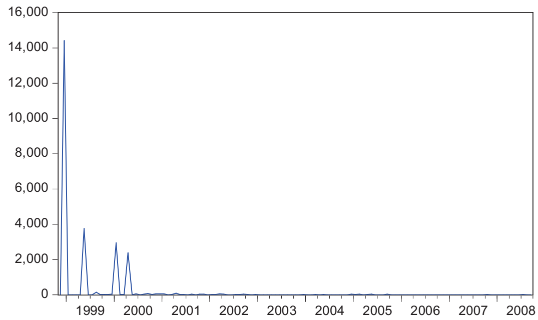
	EXRA	QMT	VALUE
Mean	0.566	7,171	1,891,372
Maximum	0.642	54,448	12,937,328
Minimum	0.447	0	0
Std. Dev.	0.047	12,716	2,843,156
Skewness	-0.597	2.043	1.995
Kurtosis	2.839	6.451	6.519
Jarque-Bera	7.190	141.815	140.367
Sum	67.368	853,370	2.25E+08
Sum Sq. Dev.	0.259	1.91E+10	9.54E+14
Observations	119	119	119

2.2.1.14 Lithuania

EXRA



QMT



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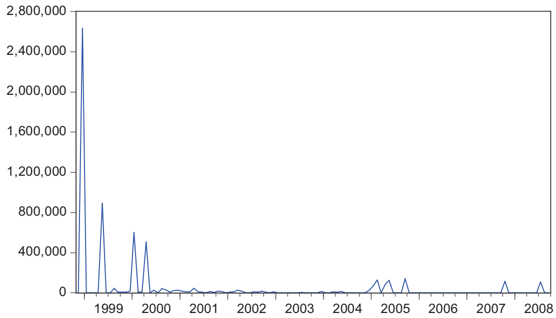
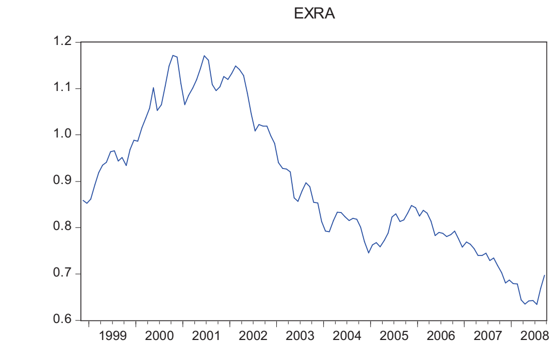
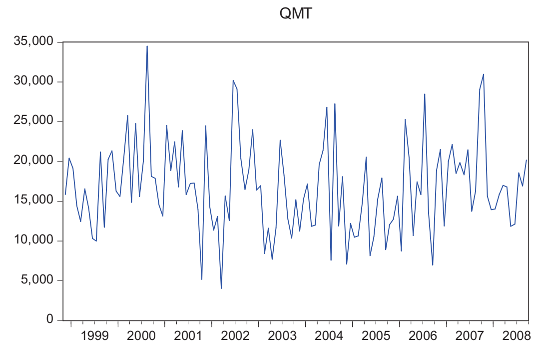


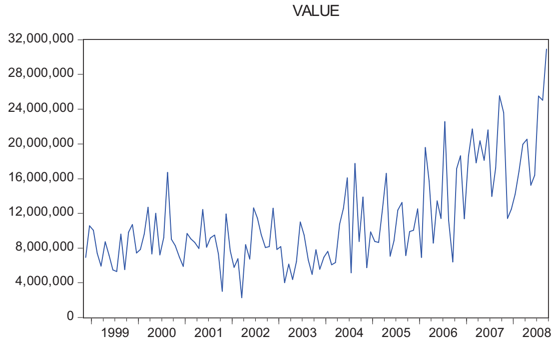
Descriptive Statistics - Lithuania

	EXRA	QMT	VALUE
Mean	3.224	210	50,083
Maximum	4.003	14,423	2,633,652
Minimum	2.204	0	0
Std. Dev.	0.638	1,400	262,804
Skewness	0.135	9.130	8.483
Kurtosis	1.416	91.221	80.962
Jarque-Bera	12.797	40,243.810	31,564.520
Sum	383.613	24,966	5,959,918
Sum Sq. Dev.	48.007	2.31E+08	8.15E+12
Observations	119	119	119

2.2.1.15 Luxembourg



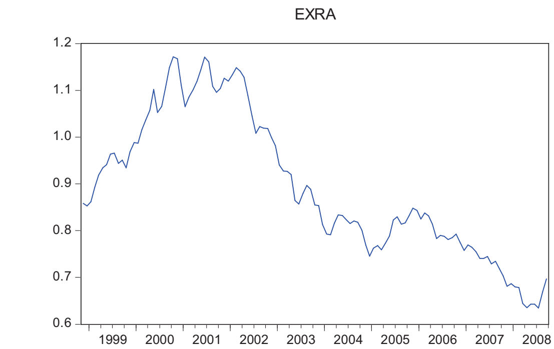


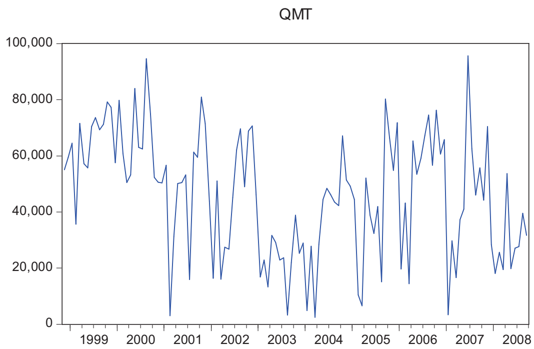


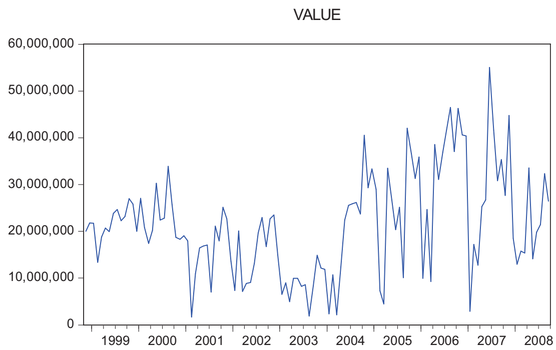
Descriptive Statistics - Luxembourg

	EXRA	QMT	VALUE
Mean	0.893	16,648	11,157,436
Maximum	1.172	34,513	30,915,308
Minimum	0.635	4,032	2,287,080
Std. Dev.	0.151	5,728	5,455,461
Skewness	0.290	0.523	1.169
Kurtosis	1.960	3.302	4.059
Jarque-Bera	7.034	5.872	32.659
Sum	106.313	1,981,063	1.33E+09
Sum Sq. Dev.	2.682	3.87E+09	3.51E+15
Observations	119	119	119

2.2.1.16 Netherlands



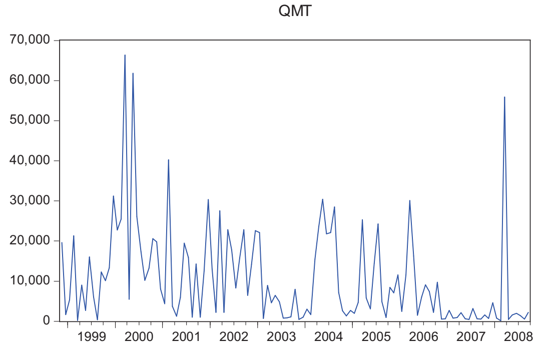


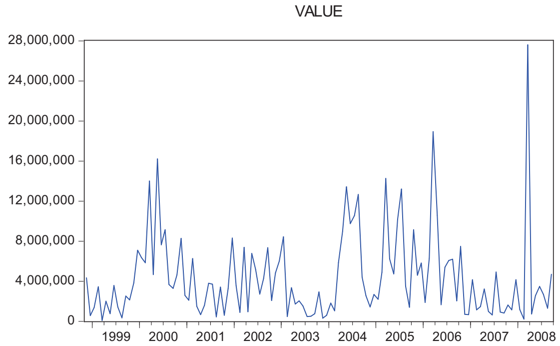


Descriptive Statistics - Netherlands

	EXRA	QMT	VALUE
Mean	0.893	46,209	21,438,890
Maximum	1.172	95,610	55,083,454
Minimum	0.635	2,491	1,656,878
Std. Dev.	0.151	21,950	11,103,068
Skewness	0.290	-0.124	0.461
Kurtosis	1.960	2.226	2.890
Jarque-Bera	7.034	3.271	4.268
Sum	106.313	5,498,873	2.55E+09
Sum Sq. Dev.	2.682	5.69E+10	1.45E+16
Observations	119	119	119

2.2.1.17 Poland

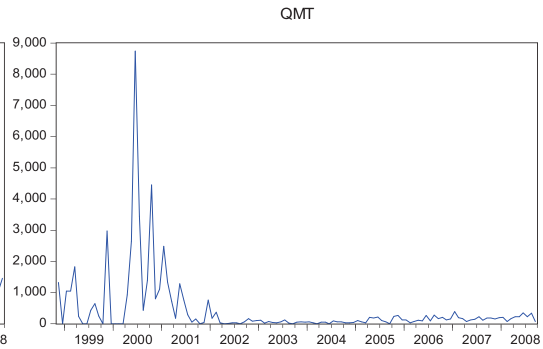


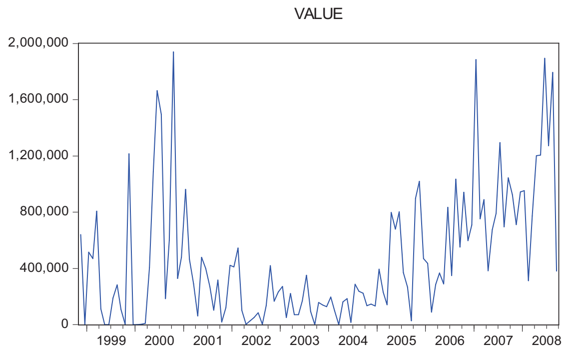


Descriptive Statistics - Poland

	EXRA	QMT	VALUE
Mean	3.573	10,788	4,391,065
Maximum	4.641	66,375	27,587,341
Minimum	2.072	121	90,310
Std. Dev.	0.628	12,407	4,316,920
Skewness	-0.621	2.009	2.186
Kurtosis	2.416	8.222	9.916
Jarque-Bera	9.341	215.230	331.914
Sum	425.200	1,283,735	5.23E+08
Sum Sq. Dev.	46.577	1.82E+10	2.20E+15
Observations	119	119	119

2.2.1.18 Portugal



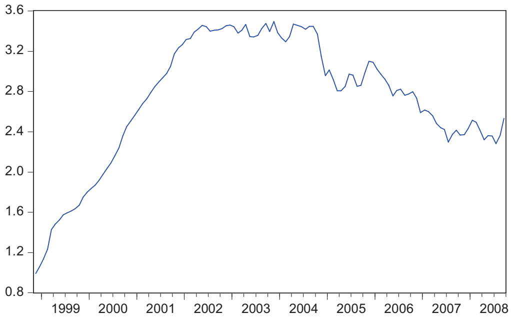


Descriptive Statistics - Portugal

	EXRA	QMT	VALUE
Mean	0.893	434	466,932
Maximum	1.172	8,743	1,939,332
Minimum	0.635	0	0
Std. Dev.	0.151	1,041	459,955
Skewness	0.290	5.320	1.339
Kurtosis	1.960	37.897	4.404
Jarque-Bera	7.034	6,599.811	45.329
Sum	106.313	51,606	55,564,939
Sum Sq. Dev.	2.682	1.28E+08	2.50E+13
Observations	119	119	119

2.2.1.19 Romania

EXRA



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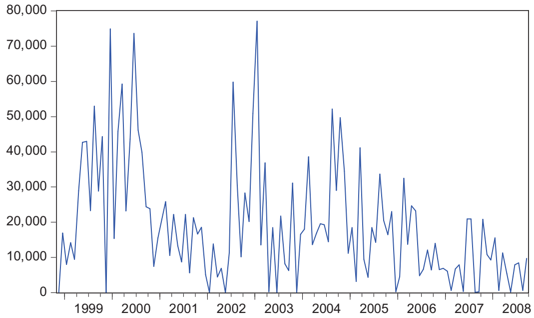

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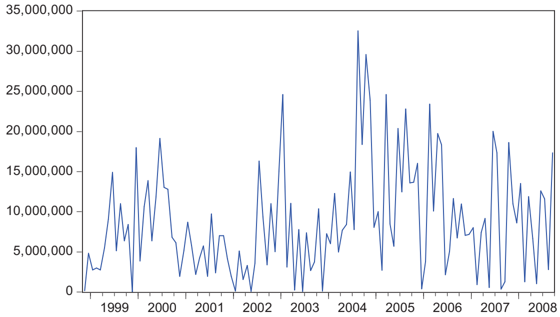
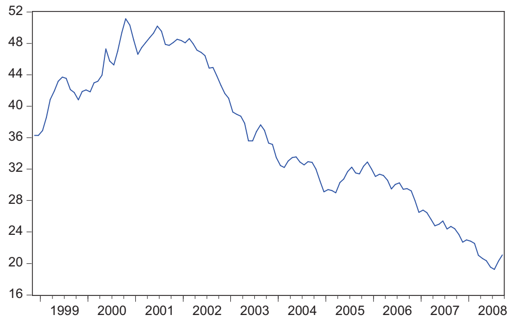


Descriptive Statistics - Romania

	EXRA	QMT	VALUE
Mean	2.720	19,386	8,829,051
Maximum	3.496	77,104	32,526,515
Minimum	0.993	0	0
Std. Dev.	0.636	16,987	6,846,883
Skewness	-0.763	1.316	1.008
Kurtosis	2.866	4.583	3.789
Jarque-Bera	11.646	46.793	23.253
Sum	323.737	2,306,890	1.05E+09
Sum Sq. Dev.	47.695	3.40E+10	5.53E+15
Observations	119	119	119

2.2.1.20 Slovakia

EXRA



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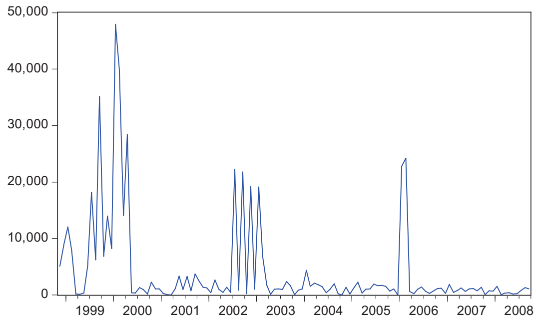

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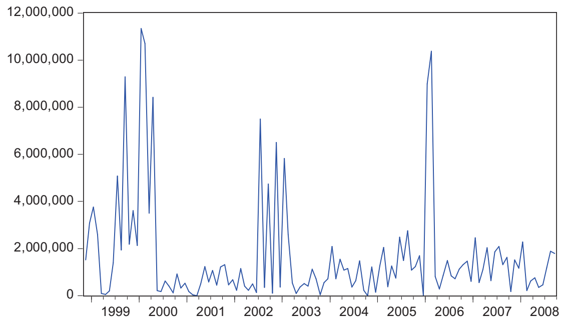
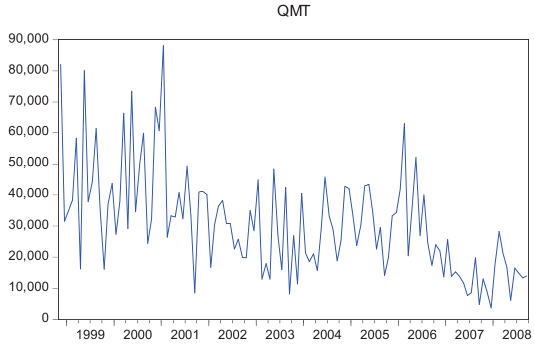
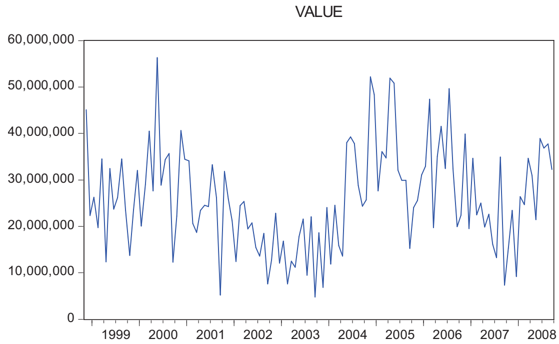


Descriptive Statistics - Slovakia

	EXRA	QMT	VALUE
Mean	36.086	4,158	1,678,266
Maximum	51.145	47,915	11,344,035
Minimum	19.272	0	2,737
Std. Dev.	8.927	8,296	2,302,846
Skewness	-0.044	3.104	2.629
Kurtosis	1.855	13.056	9.661
Jarque-Bera	6.536	692.541	357.116
Sum	4,294.215	494,852	2.00E+08
Sum Sq. Dev.	9,403.579	8.12E+09	6.26E+14
Observations	119	119	119

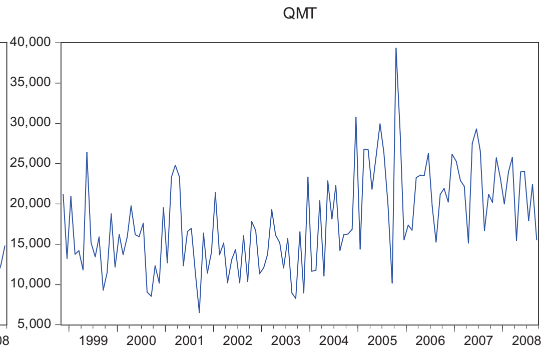
2.2.1.21 Spain

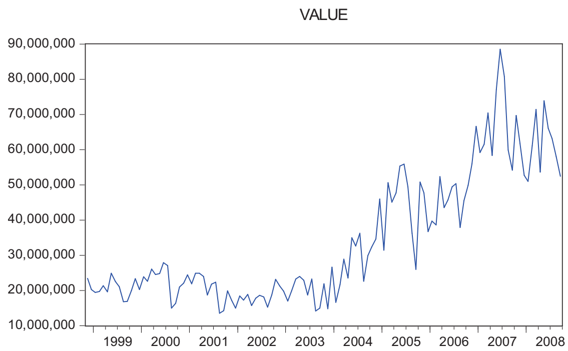




Descriptive Statistics - Spain			
	EXRA	QMT	VALUE
Mean	0.893	30,881	25,986,076
Maximum	1.172	88,109	56,353,147
Minimum	0.635	3,567	4,785,222
Std. Dev.	0.151	16,891	11,019,209
Skewness	0.290	1.021	0.395
Kurtosis	1.960	4.166	2.895
Jarque-Bera	7.034	27.407	3.144
Sum	106.313	3,674,850	3.09E+09
Sum Sq. Dev.	2.682	3.37E+10	1.43E+16
Observations	119	119	119

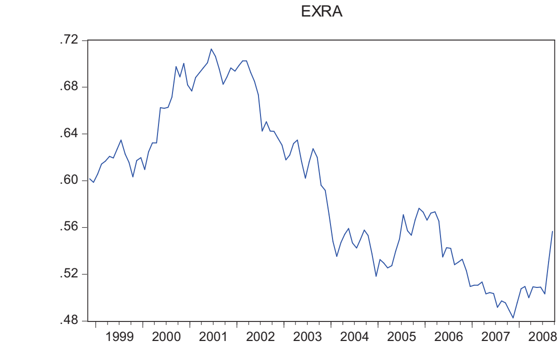
2.2.1.22 Sweden

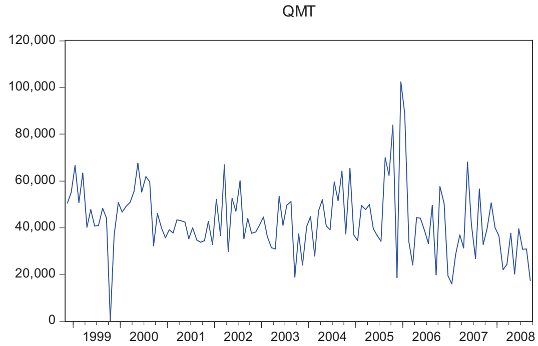


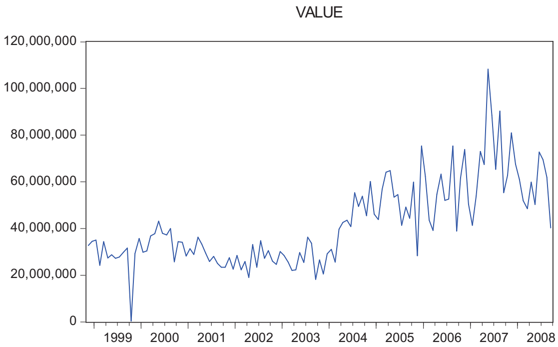


Descriptive Statistics - Sweden			
	EXRA	QMT	VALUE
Mean	8.120	17,991	34,318,257
Maximum	10.793	39,328	88,541,241
Minimum	5.947	6,525	13,560,492
Std. Dev.	1.285	5,971	18,279,353
Skewness	0.457	0.521	0.900
Kurtosis	2.303	3.102	2.711
Jarque-Bera	6.547	5.431	16.475
Sum	966.276	2,140,918	4.08E+09
Sum Sq. Dev.	194.795	4.21E+09	3.94E+16
Observations	119	119	119

2.2.1.23 United Kingdom





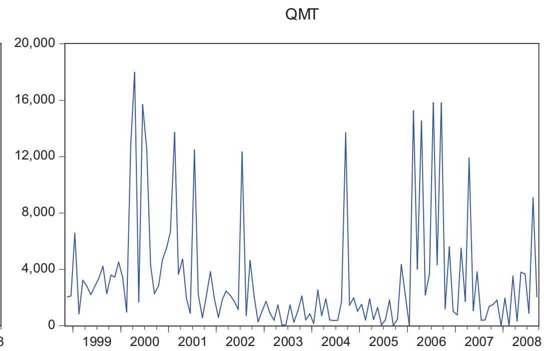


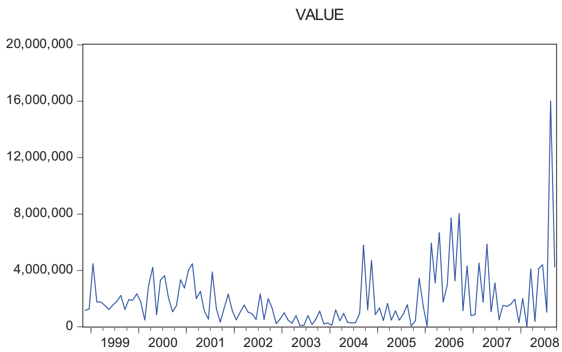
Descriptive Statistics - United Kingdom

	EXRA	QMT	VALUE
Mean	0.593	43,051.290	42,011,328.000
Maximum	0.713	102,373.800	1.08E+08
Minimum	0.483	177.338	354,256.600
Std. Dev.	0.067	14,895	18,027,786
Skewness	0.178	0.720	0.929
Kurtosis	1.777	5.170	3.825
Jarque-Bera	8.044	33.635	20.508
Sum	70.524	5,123,104	5.00E+09
Sum Sq. Dev.	0.531	2.62E+10	3.84E+16
Observations	119	119	119

2.2.2 Other Europe

2.2.2.1 Norway

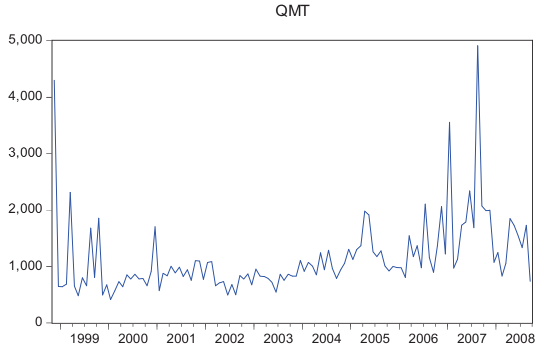


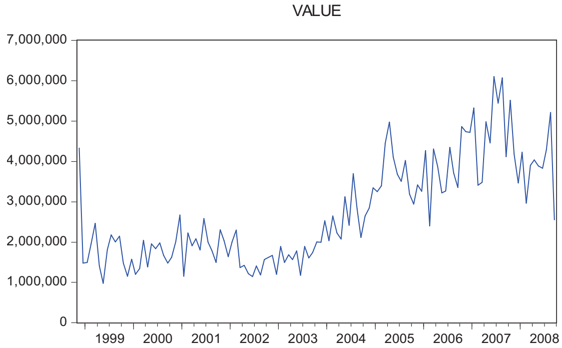


Descriptive Statistics - Norway

	EXRA	QMT	VALUE
Mean	7.192	3,405	1,969,592
Maximum	9.379	17,992	15,998,890
Minimum	5.054	3	25,797
Std. Dev.	1.185	4,167	2,113,650
Skewness	0.204	1.983	3.118
Kurtosis	2.075	5.976	18.409
Jarque-Bera	5.065	121.914	1,370.127
Sum	855.901	405,140	2.34E+08
Sum Sq. Dev.	165.578	2.05E+09	5.27E+14
Observations	119	119	119

2.2.2.2 Switzerland



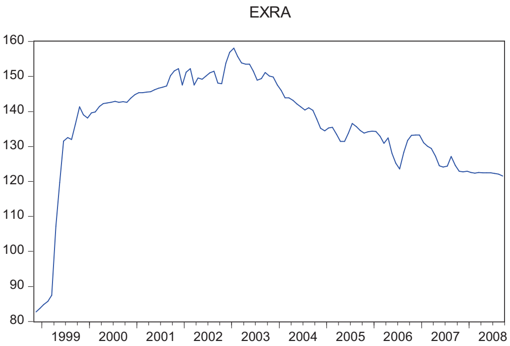


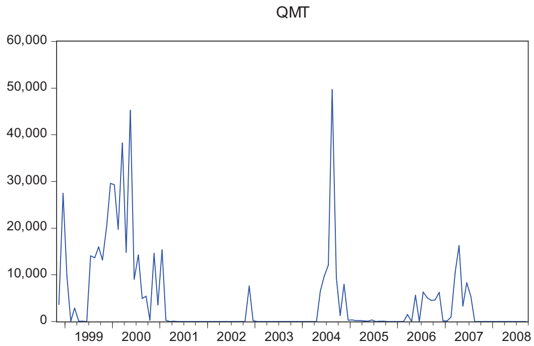
Descriptive Statistics - Switzerland

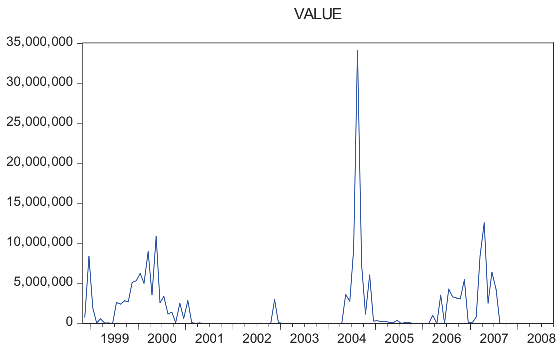
	EXRA	QMT	VALUE
Mean	1.386	1,148.955	2,729,521
Maximum	1.786	4,912.073	6,104,008
Minimum	1.013	414.810	982,318
Std. Dev.	0.208	666.511	1,263,277
Skewness	0.310	2.980	0.714
Kurtosis	1.950	14.913	2.535
Jarque-Bera	7.369	879.769	11.196
Sum	164.971	136,726	3.25E+08
Sum Sq. Dev.	5.119	52,419,896	1.88E+14
Observations	119	119	119

2.2.3 C.I.S.

2.2.3.1 Kazakhstan



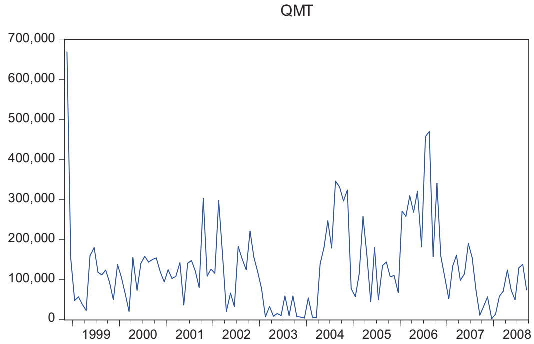


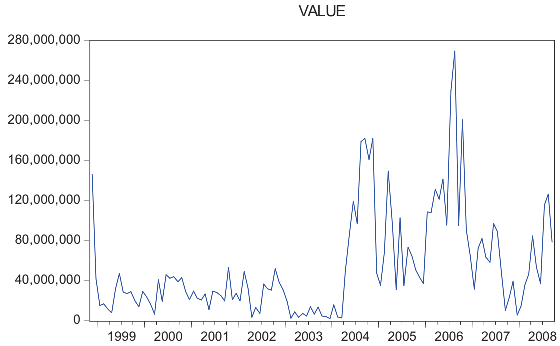


Descriptive Statistics - Kazakhstan

	EXRA	QMT	VALUE
Mean	136.067	4,622.343	1,754,875
Maximum	158.070	49,686.600	34,105,056
Minimum	82.694	0	0
Std. Dev.	14.917	9,129.293	3,961,657
Skewness	-1.599	2.792	5.134
Kurtosis	6.528	11.576	39.167
Jarque-Bera	112.431	519.272	7,008.664
Sum	16,191.930	550,058.900	2.09E+08
Sum Sq. Dev.	26,258.000	9.83E+09	1.85E+15
Observations	119	119	119

2.2.3.2 Russia

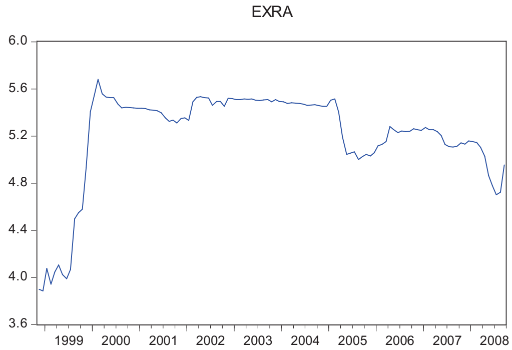


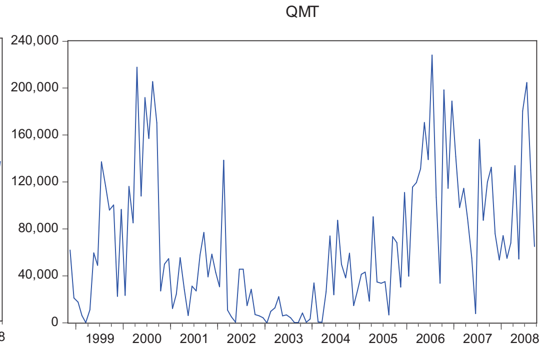


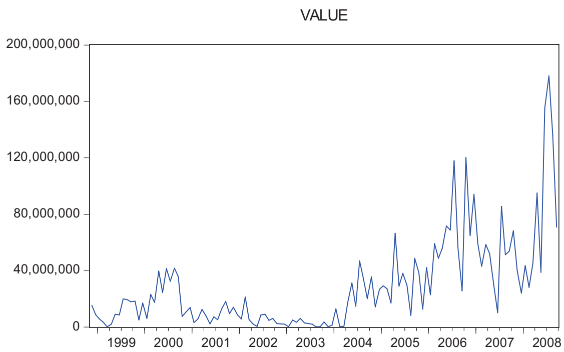
Descriptive Statistics - Russia

	EXRA	QMT	VALUE
Mean	27.789	130,669	53,553,902
Maximum	31.859	669,636	270,000,000
Minimum	17.498	1,851.100	2,164,585.000
Std. Dev.	2.562	107,318.500	51,856,822.000
Skewness	-0.736	1.818	1.715
Kurtosis	4.078	8.178	6.002
Jarque-Bera	16.496	198.522	103.018
Sum	3,306.907	15,549,573	6.37E+09
Sum Sq. Dev.	774.506	1.36E+12	3.17E+17
Observations	119	119	119

2.2.3.3 Ukraine





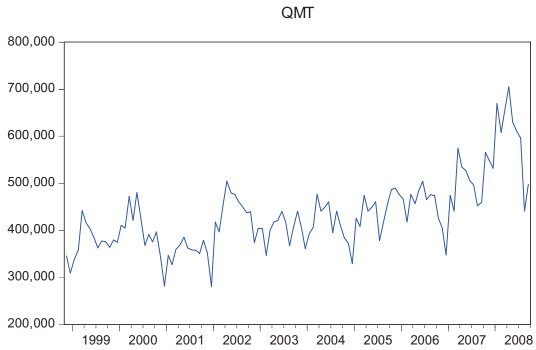


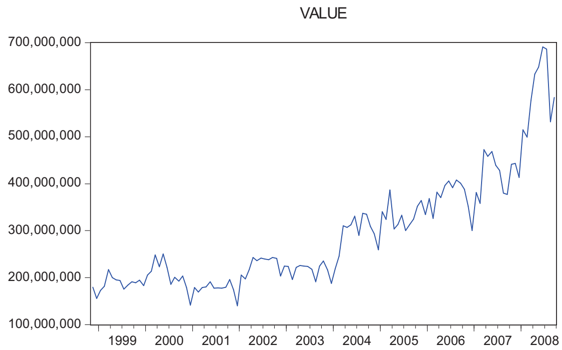
Descriptive Statistics - Ukraine

	EXRA	QMT	VALUE
Mean	5.204	65,437.620	29,113,190
Maximum	5.681	227,996	1.78E+08
Minimum	3.886	118.200	110,933
Std. Dev.	0.415	58,104.680	32,796,135
Skewness	-1.864	0.942	2.056
Kurtosis	5.842	3.028	8.047
Jarque-Bera	108.964	17.592	210.157
Sum	619.266	7,787,077	3.46E+09
Sum Sq. Dev.	20.348	3.98E+11	1.27E+17
Observations	119	119	119

2.2.4 North America

2.2.4.1 Canada

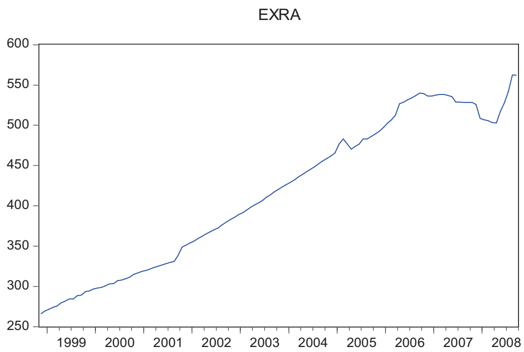


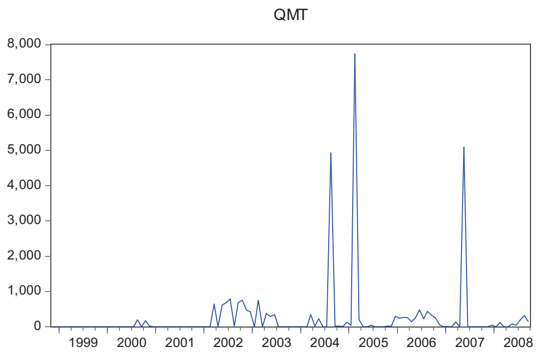


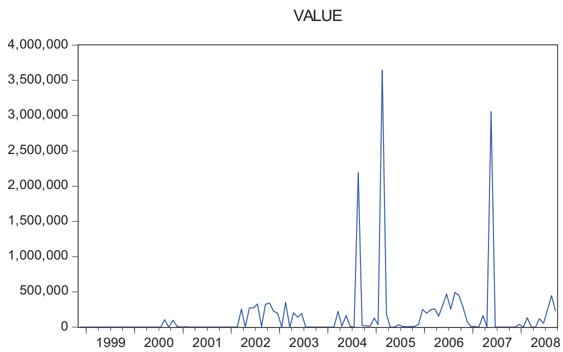
Descriptive Statistics - Canada

	EXRA	QMT	VALUE
Mean	1.335	433,530.400	2.94E+08
Maximum	1.600	705,445.800	6.92E+08
Minimum	0.967	280,173.700	1.40E+08
Std. Dev.	0.195	77,208.740	1.23E+08
Skewness	-0.305	1.043	1.240
Kurtosis	1.674	4.574	4.206
Jarque-Bera	10.564	33.849	37.728
Sum	158.815	51,590,117.000	3.50E+10
Sum Sq. Dev.	4.503	7.03E+11	1.77E+18
Observations	119	119	119

2.2.4.2 Costa Rica



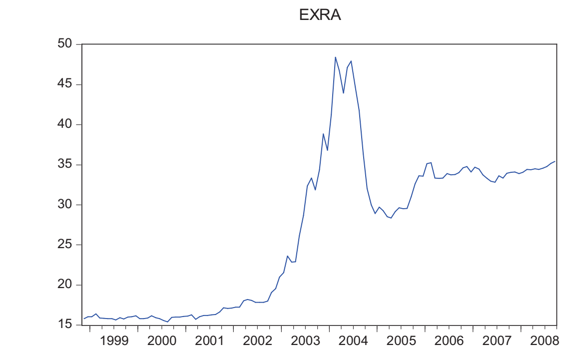


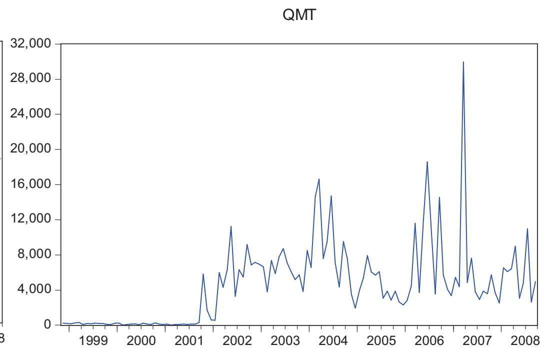


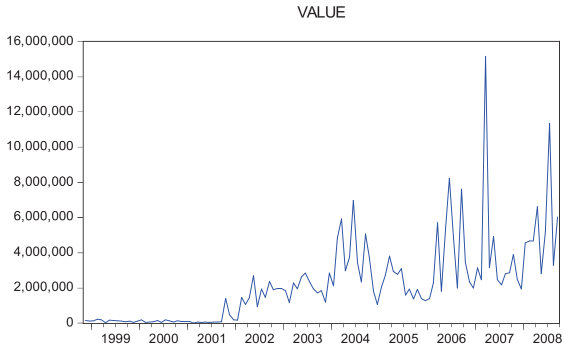
Descriptive Statistics - Costa Rica

	EXRA	QMT	VALUE
Mean	416.803	255.558	151,113
Maximum	562.435	7,741.794	3,645,949
Minimum	266.214	0	0
Std. Dev.	91.704	957.060	480,510
Skewness	-0.080	6.153	5.797
Kurtosis	1.579	42.410	38.111
Jarque-Bera	10.141	8,451.955	6,778.975
Sum	49,599.590	30,411.410	17,982,441
Sum Sq. Dev.	992,338.600	1.08E+08	2.72E+13
Observations	119	119	119

2.2.4.3 Dominican Republic



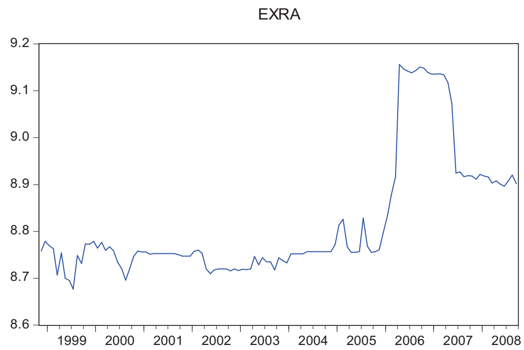


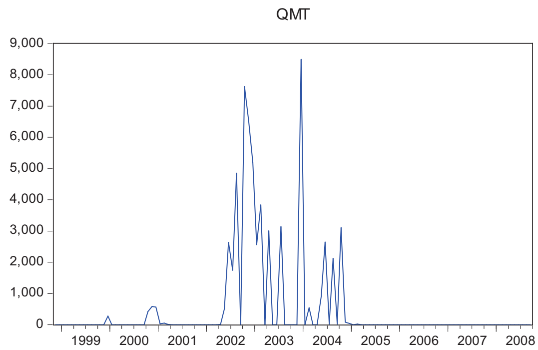


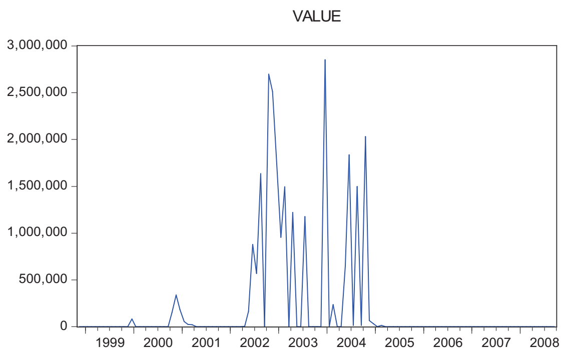
Descriptive Statistics - Dominican Republic

	EXRA	QMT	VALUE
Mean	26.585	4,609	2,219,503
Maximum	48.406	29,977	15,155,623
Minimum	15.412	3.502	3,515.768
Std. Dev.	9.477	4,641.501	2,377,966
Skewness	0.239	1.939	2.200
Kurtosis	1.878	9.780	10.649
Jarque-Bera	7.377	302.496	386.038
Sum	3,163.595	548,436	2.64E+08
Sum Sq. Dev.	10,598.070	2.54E+09	6.67E+14
Observations	119	119	119

2.2.4.4 El Salvador



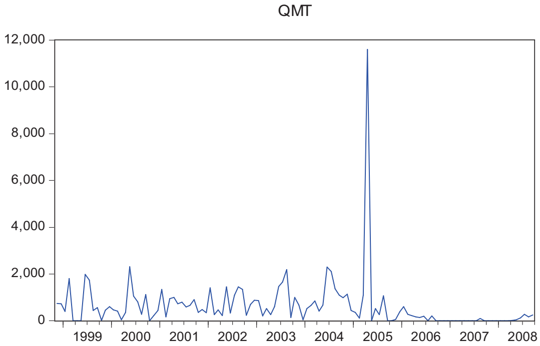


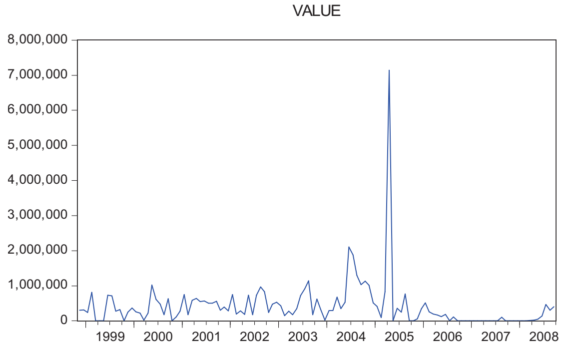


Descriptive Statistics - El Salvador

	EXRA	QMT	VALUE
Mean	8.819	517.885	211,307
Maximum	9.156	8,498.880	2,852,173
Minimum	8.677	0	0
Std. Dev.	0.132	1,499.229	579,692.200
Skewness	1.557	3.473	3.008
Kurtosis	4.188	15.335	11.388
Jarque-Bera	55.055	993.717	528.224
Sum	1,049.445	61,628	25,145,505
Sum Sq. Dev.	2.058	2.65E+08	3.97E+13
Observations	119	119	119

2.2.4.5 Guatemala

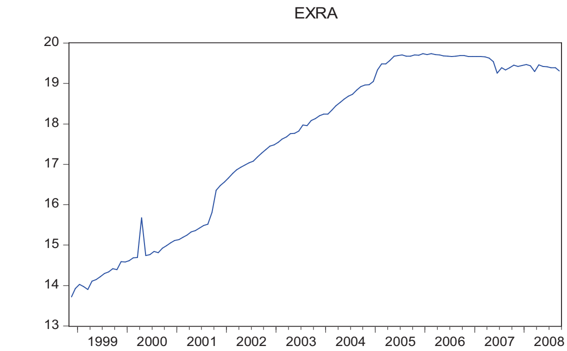


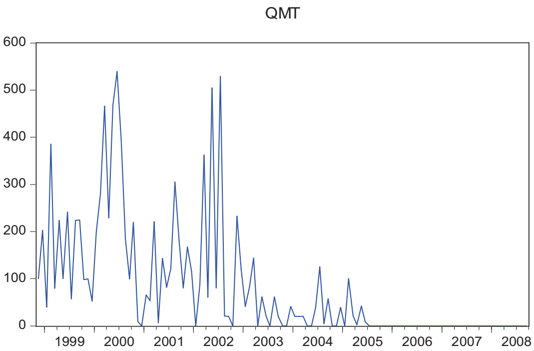


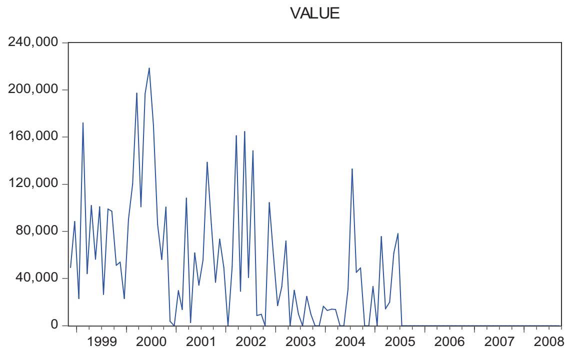
Descriptive Statistics - Guatemala

	EXRA	QMT	VALUE
Mean	7.847	635.756	419,660
Maximum	8.340	11,608.060	7,147,216
Minimum	6.575	0	0
Std. Dev.	0.332	1,165.259	727,941
Skewness	-1.374	7.196	6.896
Kurtosis	5.953	67.385	62.819
Jarque-Bera	80.683	21,581.760	18,685.440
Sum	933.805	75,655	49,939,515
Sum Sq. Dev.	12.996	1.60E+08	6.25E+13
Observations	119	119	119

2.2.4.6 Honduras



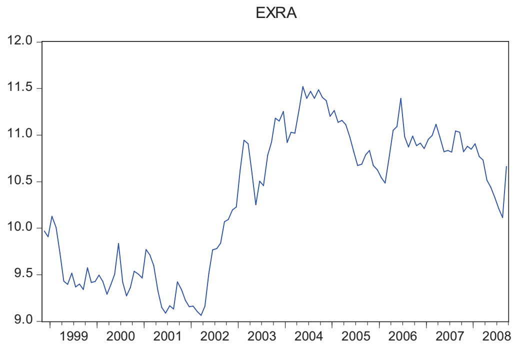


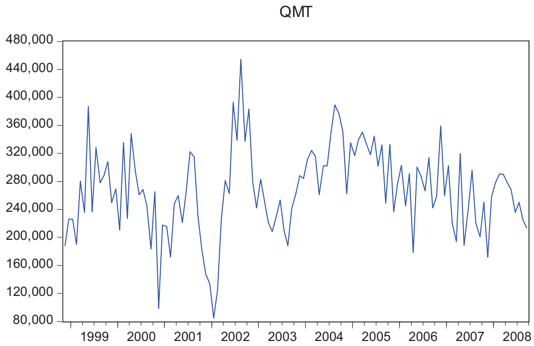


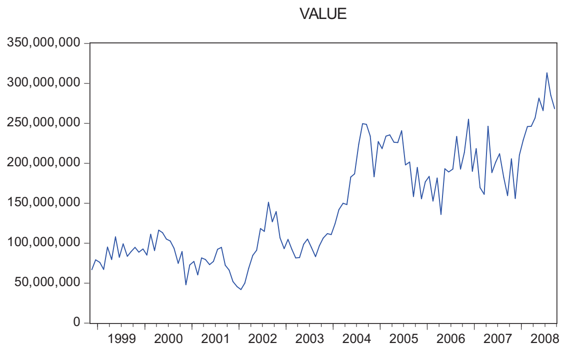
Descriptive Statistics - Honduras

	EXRA	QMT	VALUE
Mean	17.559	81.975	38,573.190
Maximum	19.739	539.472	218,586.700
Minimum	13.718	0	0
Std. Dev.	2.046	126.861	52,387.110
Skewness	-0.489	1.972	1.510
Kurtosis	1.698	6.433	4.604
Jarque-Bera	13.144	135.593	58.001
Sum	2,089.563	9,755	4,590,209
Sum Sq. Dev.	493.932	1,899,043	3.24E+11
Observations	119	119	119

2.2.4.7 Mexico



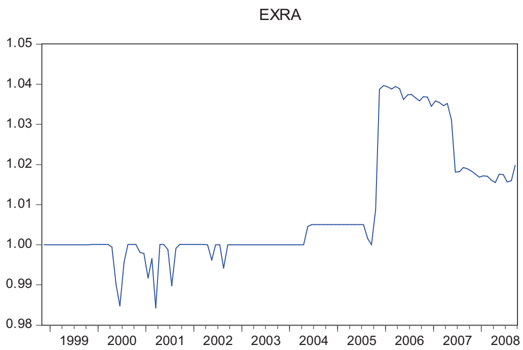


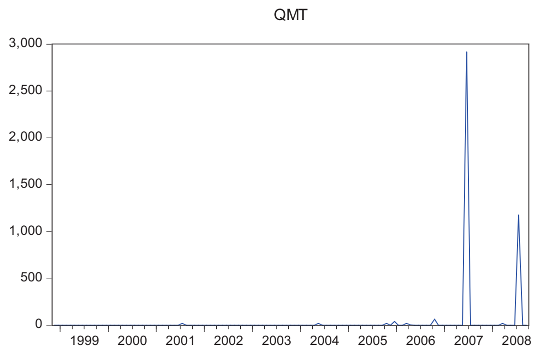


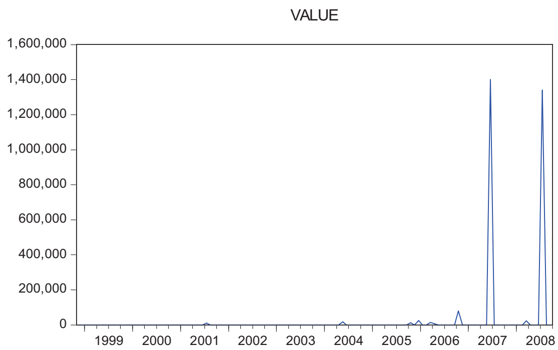
Descriptive Statistics - Mexico

	EXRA	QMT	VALUE
Mean	10.324	267,181.800	1.45E+08
Maximum	11.520	454,127.400	3.13E+08
Minimum	9.064	85,010.500	41,745,343.000
Std. Dev.	0.753	62,570.940	67,198,425.000
Skewness	-0.232	-0.115	0.437
Kurtosis	1.587	3.476	1.975
Jarque-Bera	10.971	1.386	8.996
Sum	1,228.589	31,794,635	1.73E+10
Sum Sq. Dev.	66.820	4.62E+11	5.33E+17
Observations	119	119	119

2.2.4.8 Panama



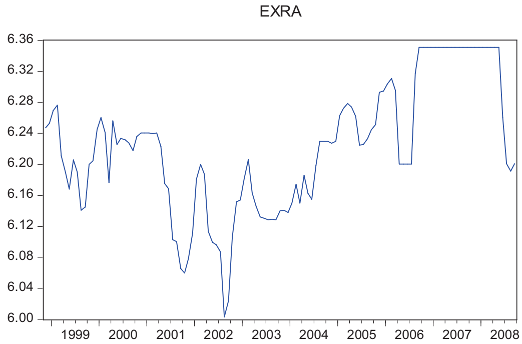


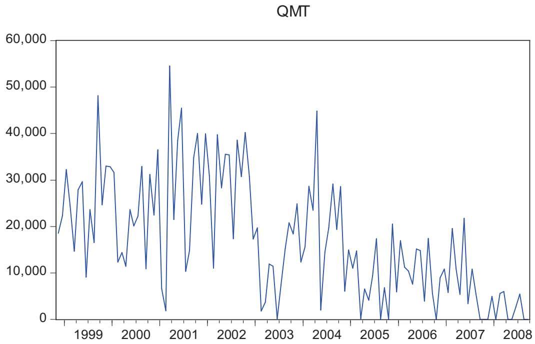


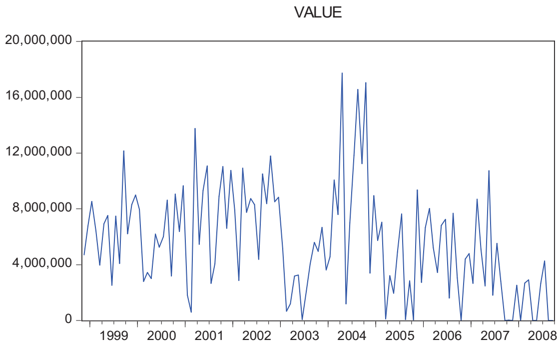
Descriptive Statistics - Panama

	EXRA	QMT	VALUE
Mean	1.008	36.034	24,570.160
Maximum	1.040	2,917	1,400,450
Minimum	0.984	0	0
Std. Dev.	0.014	287.283	176,894.400
Skewness	1.108	9.109	7.500
Kurtosis	3.011	88.537	57.395
Jarque-Bera	24.369	37,923.470	15,786.150
Sum	119.981	4,288.030	2,923,849
Sum Sq. Dev.	0.024	9,738,718	3.69E+12
Observations	119	119	119

2.2.4.9 Trinidad and Tobago





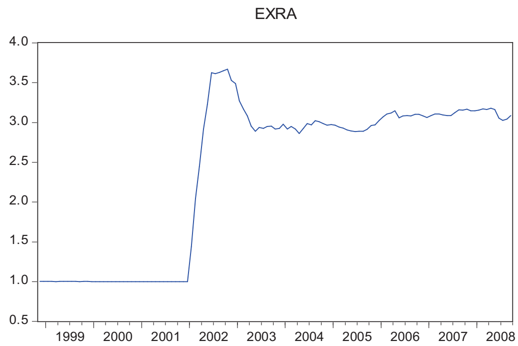


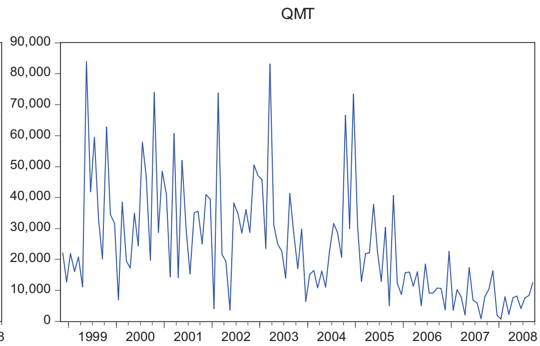
Descriptive Statistics - Trinidad and Tobago

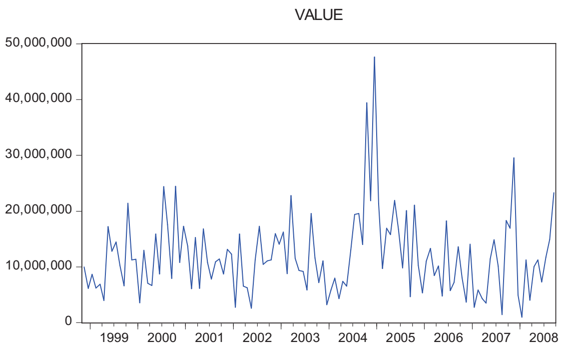
	EXRA	QMT	VALUE
Mean	6.222	17,123.470	5,610,439
Maximum	6.351	54,530.630	17,715,314
Minimum	6.003	0	0
Std. Dev.	0.084	12,882.970	3,876,151
Skewness	-0.053	0.585	0.618
Kurtosis	2.454	2.593	3.297
Jarque-Bera	1.534	7.606	8.007
Sum	740.403	2,037,693	6.68E+08
Sum Sq. Dev.	0.829	1.96E+10	1.77E+15
Observations	119	119	119

2.2.5 South America

2.2.5.1 Argentina



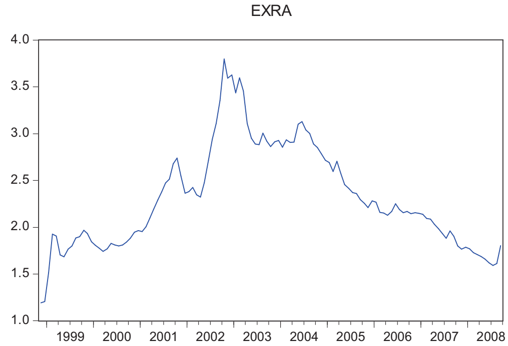


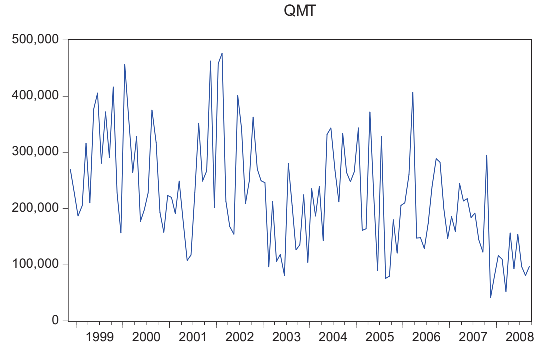


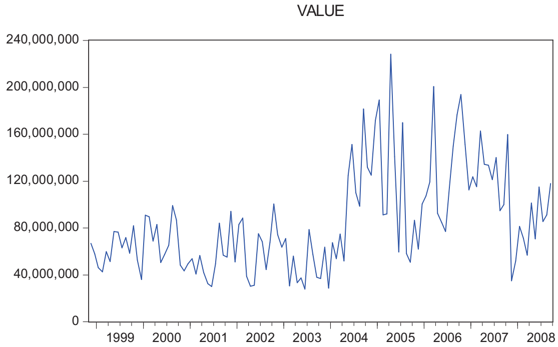
Descriptive Statistics - Argentina

	EXRA	QMT	VALUE
Mean	2.390	24,781.900	11,900,994
Maximum	3.670	83,980.270	47,644,429
Minimum	0.998	736.481	984,602
Std. Dev.	0.986	18,622.940	7,125,206
Skewness	-0.624	1.182	1.722
Kurtosis	1.553	4.090	8.508
Jarque-Bera	18.104	33.576	209.260
Sum	284.444	2,949,047	1.42E+09
Sum Sq. Dev.	114.801	4.09E+10	5.99E+15
Observations	119	119	119

2.2.5.2 Brazil



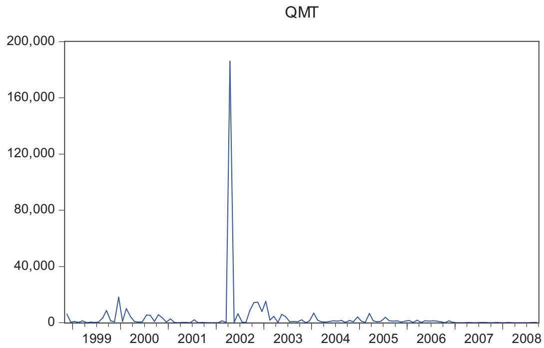


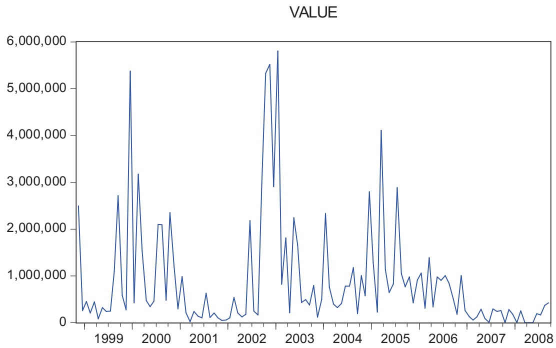


Descriptive Statistics - Brazil

	EXRA	QMT	VALUE
Mean	2.315	223,639.200	84,565,169
Maximum	3.797	476,082.200	2.28E+08
Minimum	1.193	41,518.500	27,793,602
Std. Dev.	0.550	98,009.640	42,911,375
Skewness	0.564	0.523	1.056
Kurtosis	2.684	2.755	3.682
Jarque-Bera	6.814	5.732	24.418
Sum	275.427	26,613,065.000	1.01E+10
Sum Sq. Dev.	35.650	1.13E+12	2.17E+17
Observations	119	119	119

2.2.5.3 Chile

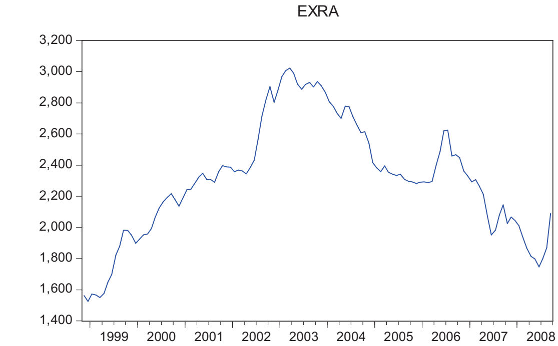


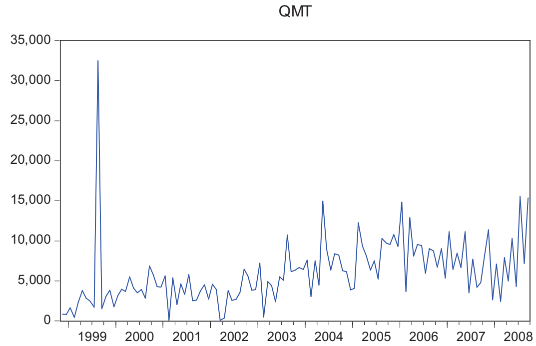


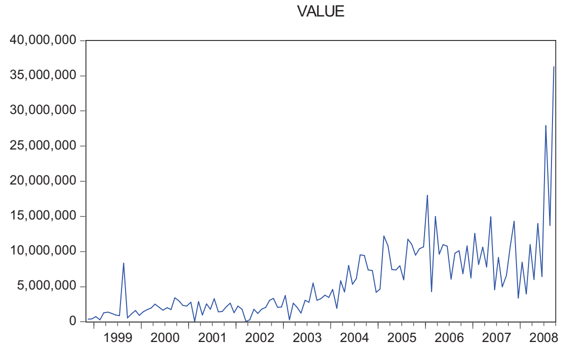
Descriptive Statistics - Chile

	EXRA	QMT	VALUE
Mean	583.248	3,599.684	902,071.900
Maximum	753.199	186,122	5,805,511
Minimum	443.692	0	0
Std. Dev.	81.764	17,199.280	1,191,916
Skewness	0.531	10.180	2.369
Kurtosis	2.113	108.405	8.752
Jarque-Bera	9.503	57,143.110	275.327
Sum	69,406.520	428,362.400	1.07E+08
Sum Sq. Dev.	788,880.800	3.49E+10	1.68E+14
Observations	119	119	119

2.2.5.4 Colombia



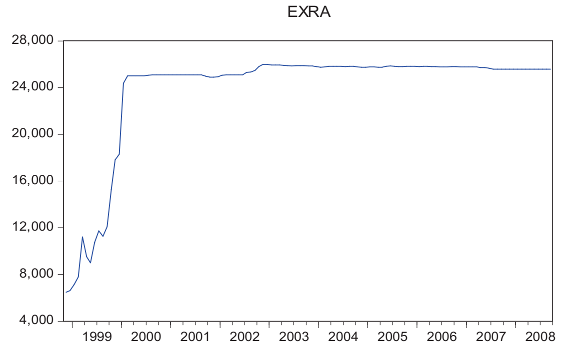


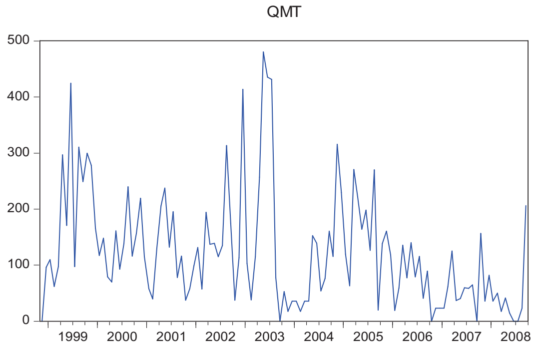


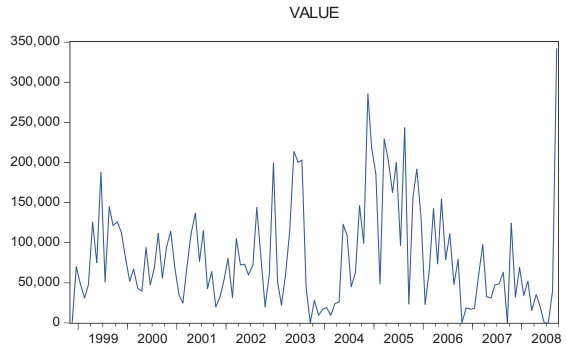
Descriptive Statistics - Colombia

	EXRA	QMT	VALUE
Mean	2,310.666	6,011.581	5,584,612
Maximum	3,023.206	32,487.570	36,331,463
Minimum	1,525.688	76.195	53,547.850
Std. Dev.	374.063	4,157.594	5,424,235.000
Skewness	-0.018	2.493	2.383
Kurtosis	2.443	15.437	12.136
Jarque-Bera	1.543	890.158	526.447
Sum	274,969.200	715,378.100	6.65E+08
Sum Sq. Dev.	16,510,918.000	2.04E+09	3.47E+15
Observations	119	119	119

2.2.5.5 Ecuador



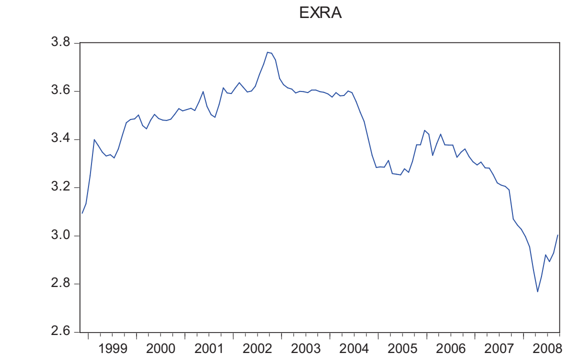


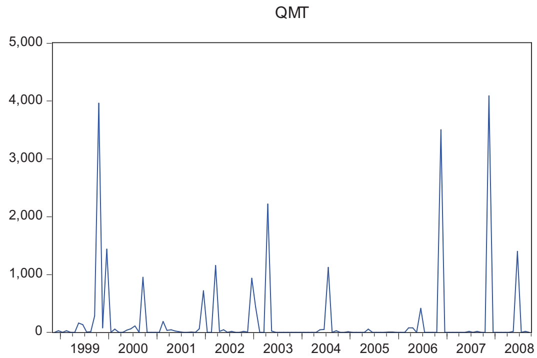


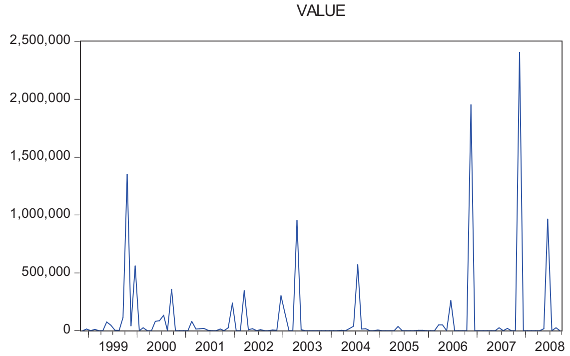
Descriptive Statistics - Ecuador

	EXRA	QMT	VALUE
Mean	23,844.370	124.932	82,518.750
Maximum	25,998.800	480.786	341,692.900
Minimum	6,477.922	0	0
Std. Dev.	4,866.862	102.863	65,900.670
Skewness	-2.620	1.328	1.268
Kurtosis	8.288	4.677	4.601
Jarque-Bera	274.767	48.912	44.577
Sum	2,837,480.000	14,866.920	9,819,731
Sum Sq. Dev.	2.79E+09	1,248,532.000	5.12E+11
Observations	119	119	119

2.2.5.6 Peru



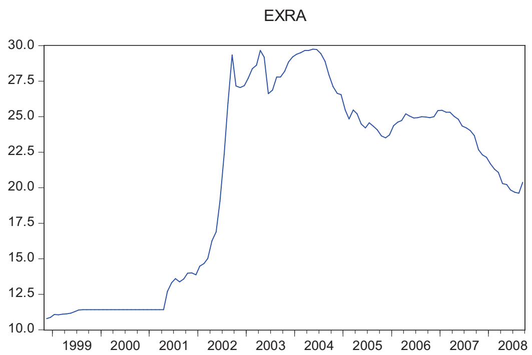


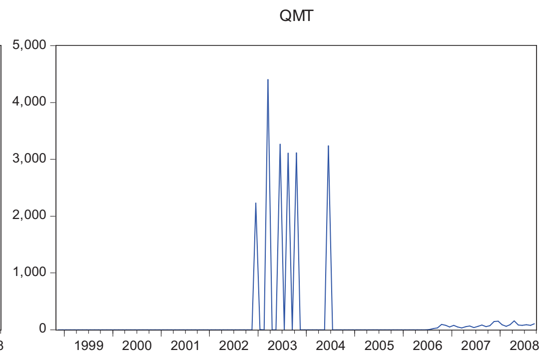


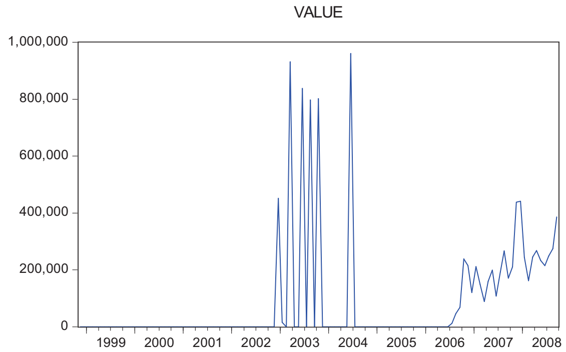
Descriptive Statistics - Peru

	EXRA	QMT	VALUE
Mean	3.405	204	97,667
Maximum	3.762	4,087	2,403,950
Minimum	2.768	0	0
Std. Dev.	0.211	677	336,104
Skewness	-0.915	4.411	4.951
Kurtosis	3.495	23.061	29.369
Jarque-Bera	17.836	2,381.369	3,933.879
Sum	405.2	24,242	11,622,354
Sum Sq. Dev.	5.269	54,139,599.000	1.33E+13
Observations	119	119	119

2.2.5.7 Uruguay





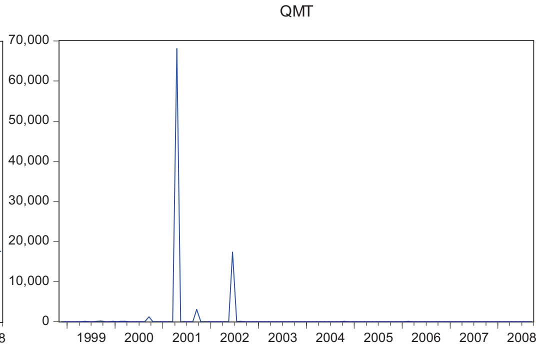


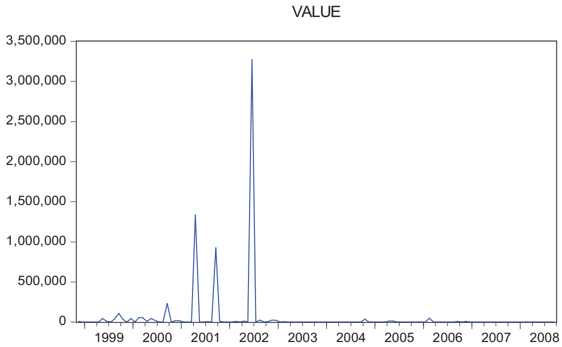
Descriptive Statistics - Uruguay

	EXRA	QMT	VALUE
Mean	20.608	179	87,415
Maximum	29.754	4,402	960,315
Minimum	10.780	0	0
Std. Dev.	6.802	720	195,528
Skewness	-0.308	4.369	2.920
Kurtosis	1.492	21.022	11.628
Jarque-Bera	13.149	1,988.962	538.196
Sum	2,452	21,317	10,402,374
Sum Sq. Dev.	5,459	61,189,153	4.51E+12
Observations	119	119	119

2.2.6 Africa

2.2.6.1 Algeria

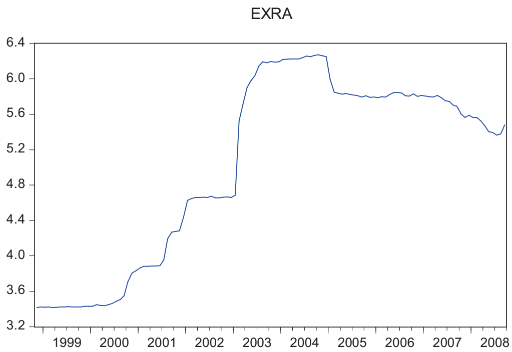


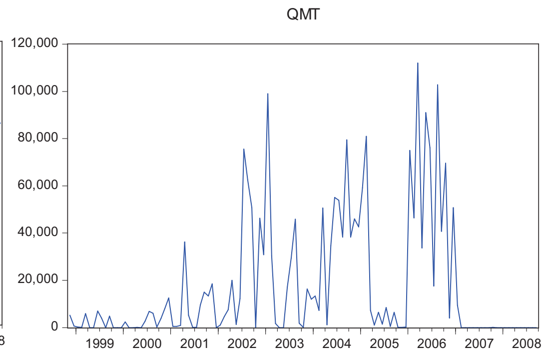


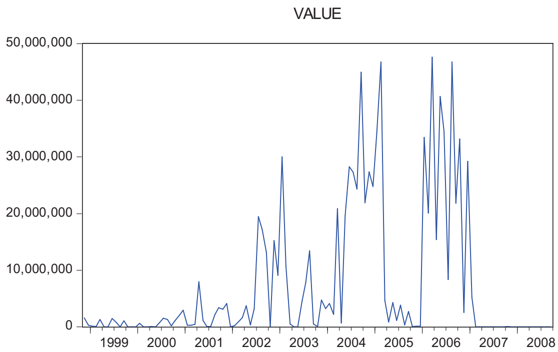
Descriptive Statistics - Algeria

	EXRA	QMT	VALUE
Mean	74.325	765	54,812
Maximum	83.317	68,099	3,272,680
Minimum	59.019	0	0
Std. Dev.	5.822	6,431	332,801
Skewness	-0.504	9.915	8.323
Kurtosis	2.569	103.110	76.951
Jarque-Bera	5.963	51,642	28,490
Sum	8,845	91,080	6,522,665
Sum Sq. Dev.	4,000	4.88E+09	1.31E+13
Observations	119	119	119

2.2.6.2 Egypt



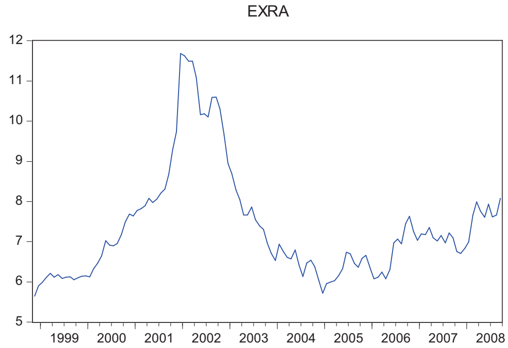


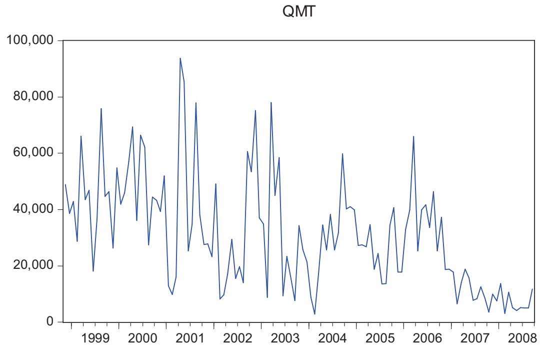


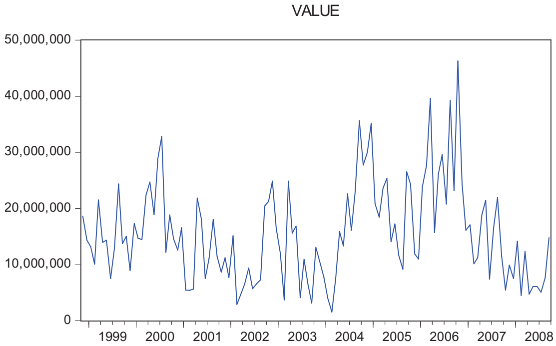
Descriptive Statistics - Egypt

	EXRA	QMT	VALUE
Mean	5.030	17,633	7,417,015
Maximum	6.273	111,951	47,613,320
Minimum	3.416	0	0
Std. Dev.	1.042	26,824	12,329,944
Skewness	-0.455	1.678	1.806
Kurtosis	1.597	4.953	5.227
Jarque-Bera	13.875	74.765	89.246
Sum	599	2,098,334	8.83E+08
Sum Sq. Dev.	128.231	8.49E+10	1.79E+16
Observations	119	119	119

2.2.6.3 South Africa





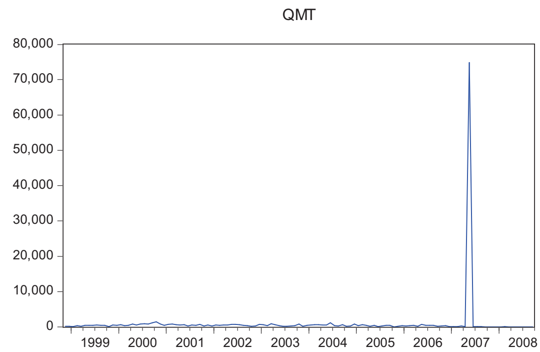


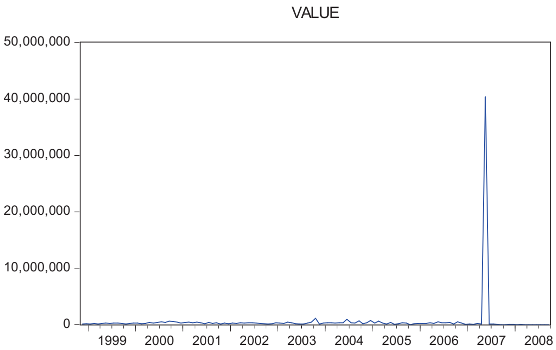
Descriptive Statistics - South Africa

	EXRA	QMT	VALUE
Mean	7.374	31,182	15,590,921
Maximum	11.676	93,699	46,275,159
Minimum	5.651	2,812	1,549,036
Std. Dev.	1.393	20,251	8,723,405
Skewness	1.487	0.776	0.870
Kurtosis	4.731	3.146	3.745
Jarque-Bera	58.692	12.051	17.753
Sum	877.5	3,710,681	1.86E+09
Sum Sq. Dev.	228.9	4.84E+10	8.98E+15
Observations	119	119	119

2.2.7 Middle East

2.2.7.1 Israel

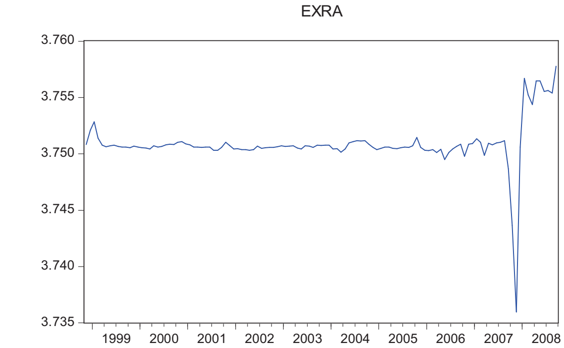


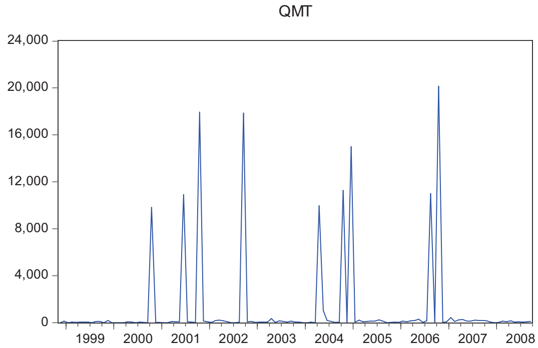


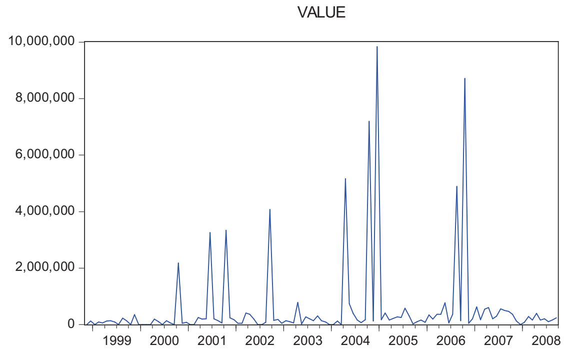
Descriptive Statistics - Israel

	EXRA	QMT	VALUE
Mean	4.300	1,027	600,836
Maximum	4.935	74,835	40,381,605
Minimum	3.358	0	0
Std. Dev.	0.328	6,829	3,682,520
Skewness	-0.681	10.742	10.727
Kurtosis	3.708	116.602	116.385
Jarque-Bera	11.695	66,278.240	66,027.000
Sum	511.747	122,175	71,499,423
Sum Sq. Dev.	12.668	5.50E+09	1.60E+15
Observations	119	119	119

2.2.7.2 Saudi Arabia



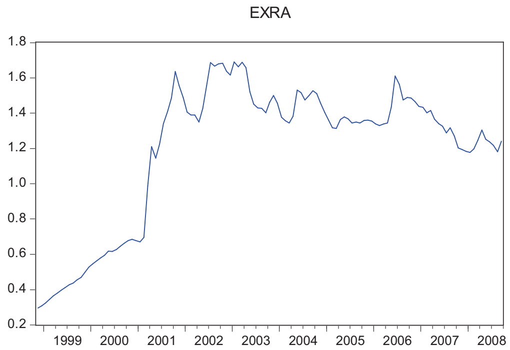


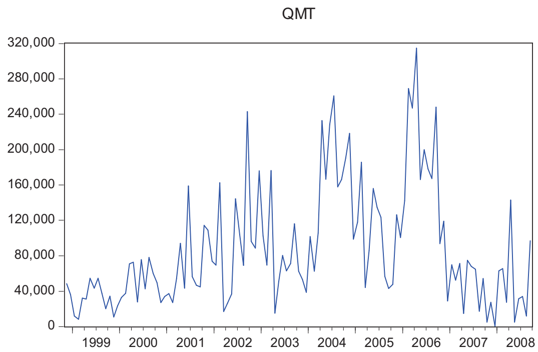


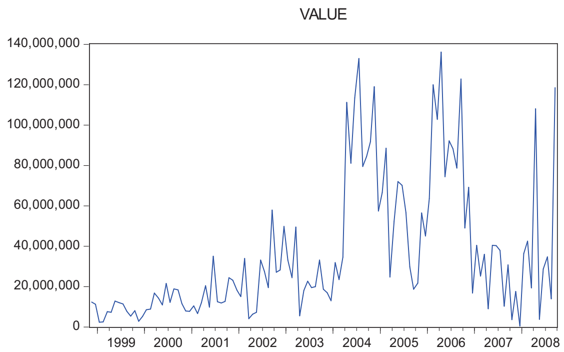
Descriptive Statistics - Saudi Arabia

	EXRA	QMT	VALUE
Mean	3.751	1,130	582,062
Maximum	3.758	20,139	9,829,239
Minimum	3.736	0	0
Std. Dev.	0.002	3,779	1,553,446
Skewness	-2.087	3.648	4.242
Kurtosis	24.275	15.376	21.478
Jarque-Bera	2,330.643	1,023.358	2,049.851
Sum	446.4	134,512	69,265,405
Sum Sq. Dev.	0.001	1.68E+09	2.85E+14
Observations	119	119	119

2.2.7.3 Turkey





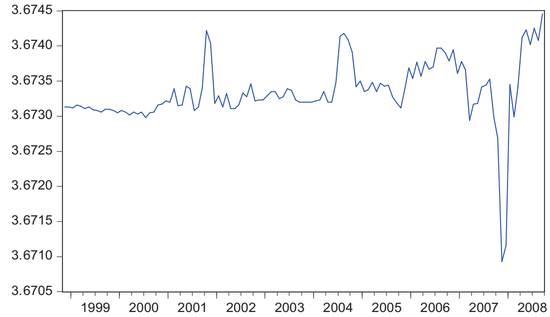


Descriptive Statistics - Turkey

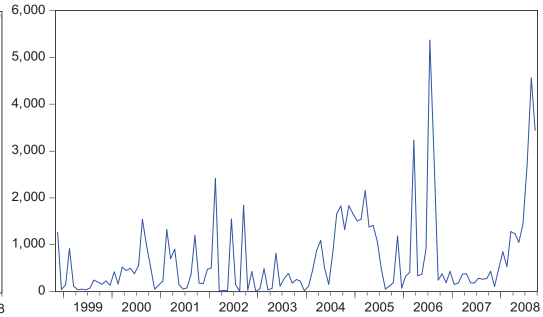
	EXRA	QMT	VALUE
Mean	1.198	87,727	36,316,487
Maximum	1.690	314,758	136,000,000
Minimum	0.296	322	367,701
Std. Dev.	0.404	67,700	33,903,255
Skewness	-0.999	1.160	1.315
Kurtosis	2.604	3.736	3.765
Jarque-Bera	20.579	29.366	37.209
Sum	142.564	10,439,508	4.32E+09
Sum Sq. Dev.	19.251	5.41E+11	1.36E+17
Observations	119	119	119

2.2.7.4 United Arab Emirates

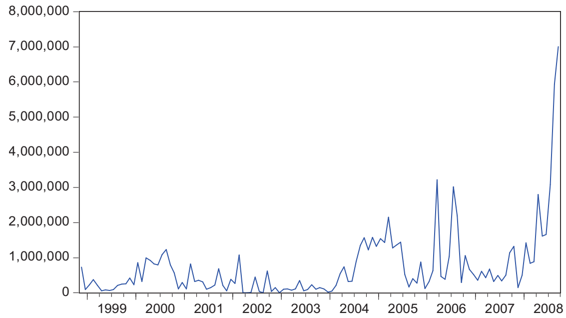
EXRA



QMT



VALUE



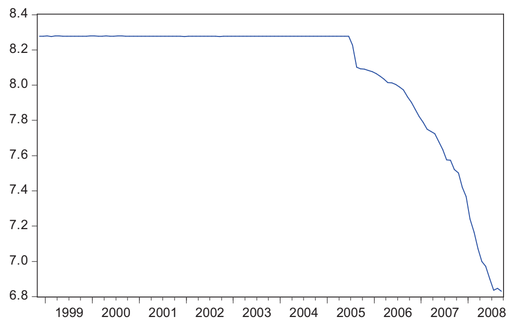
Descriptive Statistics - United Arab Emirates

	EXRA	QMT	VALUE
Mean	3.673	709	736,685
Maximum	3.674	5,368	7,008,231
Minimum	3.671	0	0
Std. Dev.	0	906	1,008,723
Skewness	-1.531	2.514	3.615
Kurtosis	12.244	10.831	19.925
Jarque-Bera	470.185	429.453	1,679.541
Sum	437.128	84,402	87,665,457
Sum Sq. Dev.	2.49E-05	96,901,336	1.20E+14
Observations	119	119	119

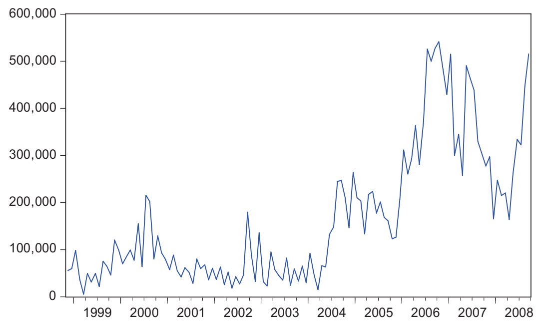
2.2.8 Asia

2.2.8.1 China

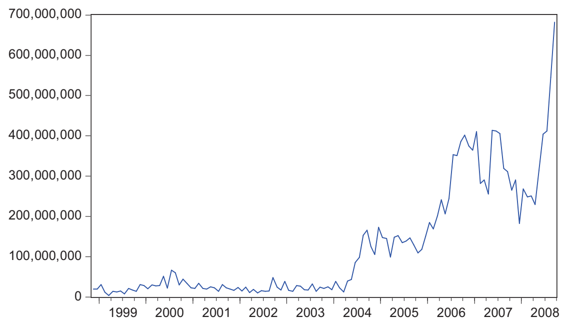
EXRA



QMT



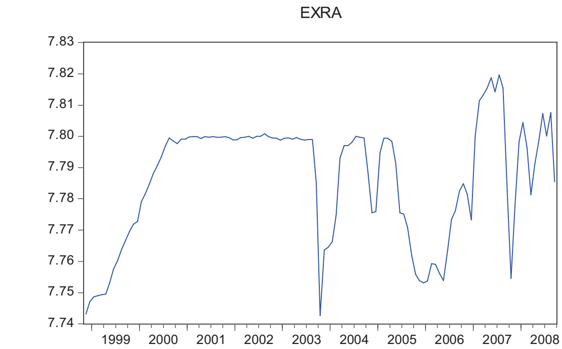
VALUE

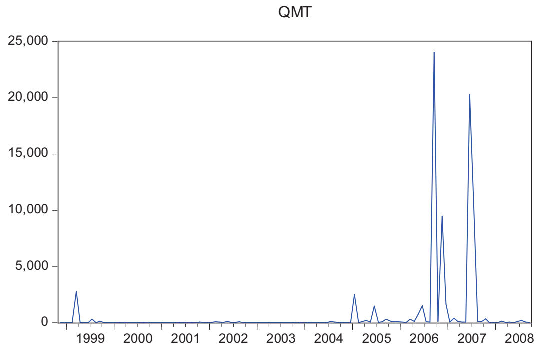


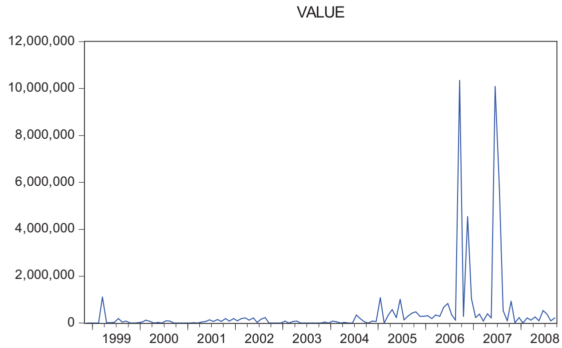
Descriptive Statistics - China

	EXRA	QMT	VALUE
Mean	8.073	166,566.800	1.25E+08
Maximum	8.280	541,854.200	6.82E+08
Minimum	6.831	5,324.874	4,151,652.000
Std. Dev.	0.382	143,826.800	1.42E+08
Skewness	-1.989	1.097	1.370
Kurtosis	5.960	3.224	4.345
Jarque-Bera	121.912	24.103	46.219
Sum	960.653	19,821,449.000	1.48E+10
Sum Sq. Dev.	17.213	2.44E+12	2.38E+18
Observations	119	119	119

2.2.8.2 Hong Kong



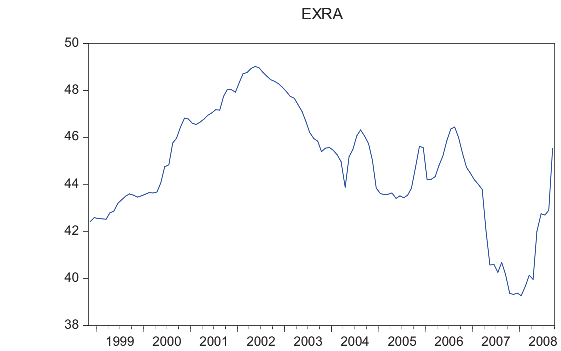


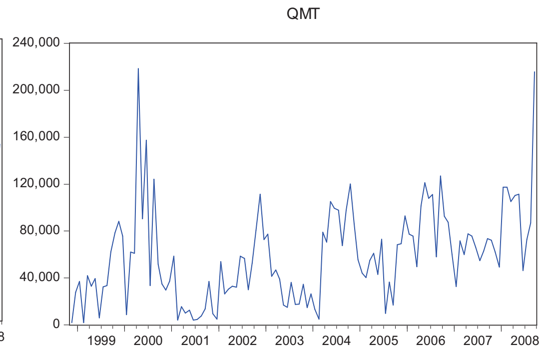


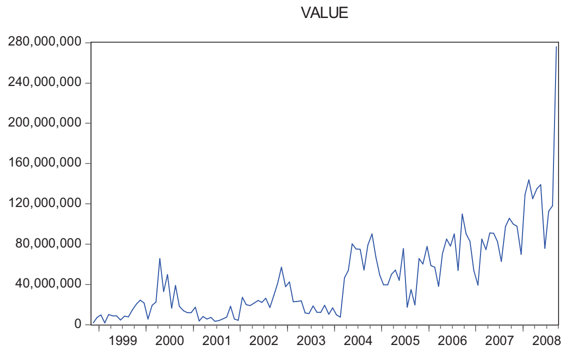
Descriptive Statistics - Hong Kong

	EXRA	QMT	VALUE
Mean	7.786	677.286	430,380
Maximum	7.820	24,020.720	10,344,866
Minimum	7.743	0	0
Std. Dev.	0.019	3,122.431	1,461,689
Skewness	-0.651	6.092	5.726
Kurtosis	2.295	41.269	36.527
Jarque-Bera	10.879	7,997.726	6,223.469
Sum	926.558	80,597	51,215,244
Sum Sq. Dev.	0.044	1.15E+09	2.52E+14
Observations	119	119	119

2.2.8.3 India



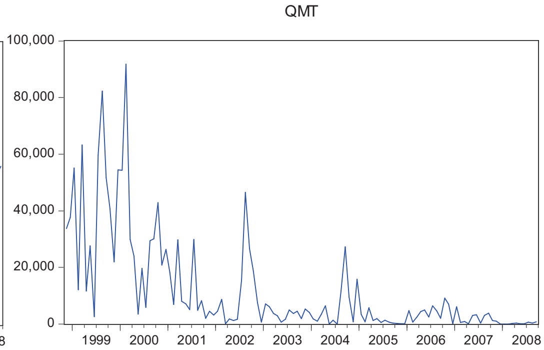


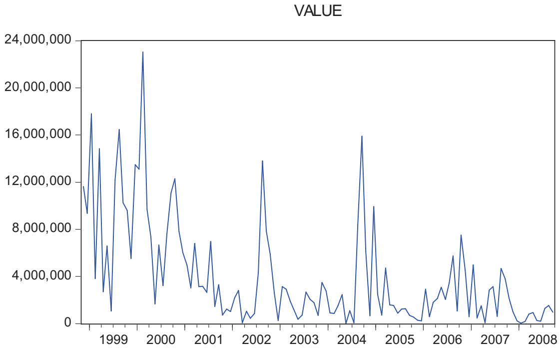


Descriptive Statistics - India

	EXRA	QMT	VALUE
Mean	44.830	58,774.250	46,298,804
Maximum	49.020	218,431.200	276,000,000
Minimum	39.270	1,888.710	1,933,298
Std. Dev.	2.459	40,217.730	42,101,986
Skewness	-0.352	1.132	1.810
Kurtosis	2.605	5.414	9.012
Jarque-Bera	3.235	54.308	244.223
Sum	5,334.726	6,994,136	5,510,000,000
Sum Sq. Dev.	713.424	1.91E+11	2.09E+17
Observations	119	119	119

2.2.8.4 Indonesia

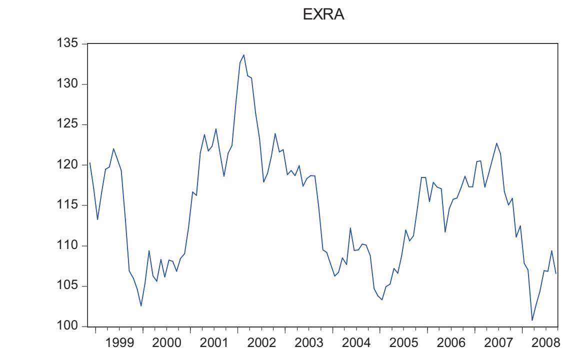


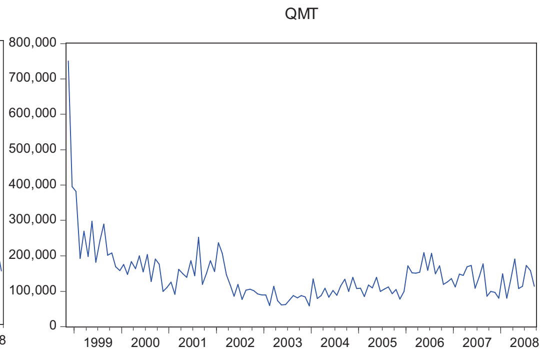


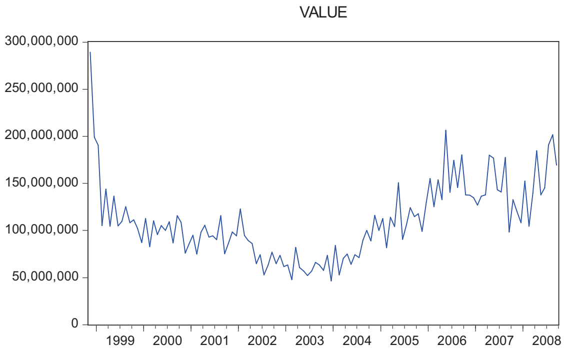
Descriptive Statistics - Indonesia

	EXRA	QMT	VALUE
Mean	9,052.103	11,854.780	4,040,970
Maximum	11,326.400	91,851.300	23,042,610
Minimum	6,797.258	7.895	29,517
Std. Dev.	819.770	17,945.190	4,478,325
Skewness	-0.047	2.206	1.723
Kurtosis	4.126	7.878	5.856
Jarque-Bera	6.331	214.486	99.298
Sum	1,077,200	1,410,719	481,000,000
Sum Sq. Dev.	79,298,755.000	3.80E+10	2.37E+15
Observations	119	119	119

2.2.8.5 Japan



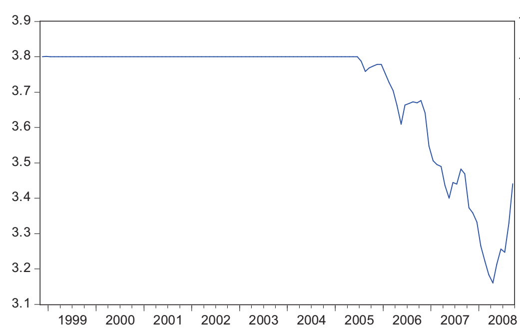


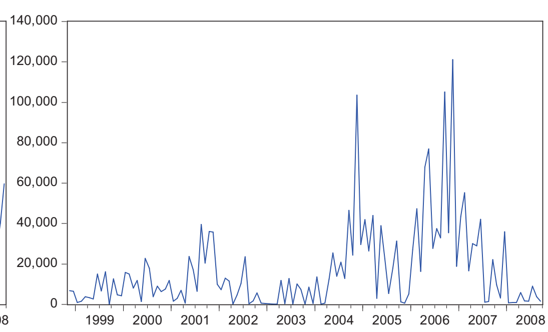


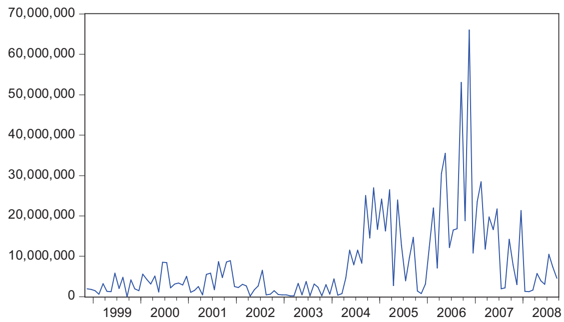
Descriptive Statistics - Japan

	EXRA	QMT	VALUE
Mean	114.534	145,723	110,000,000
Maximum	133.640	750,781	289,000,000
Minimum	100.760	58,517.350	46,662,556
Std. Dev.	7.124	81,265.530	40,743,380
Skewness	0.264	4.038	1.100
Kurtosis	2.492	28.081	5.133
Jarque-Bera	2.664	3,442.410	46.559
Sum	13,629.520	17,341,036	1.31E+10
Sum Sq. Dev.	5,989.200	7.79E+11	1.96E+17
Observations	119	119	119

2.2.8.6 Malaysia



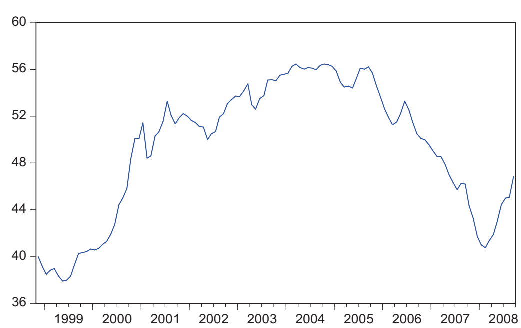


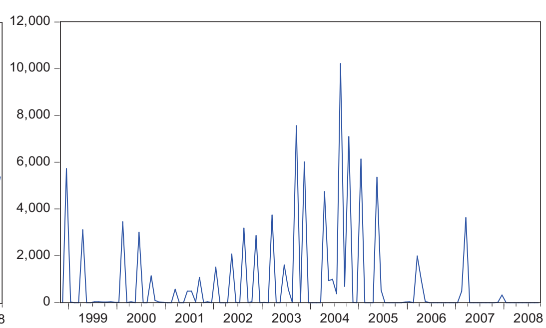


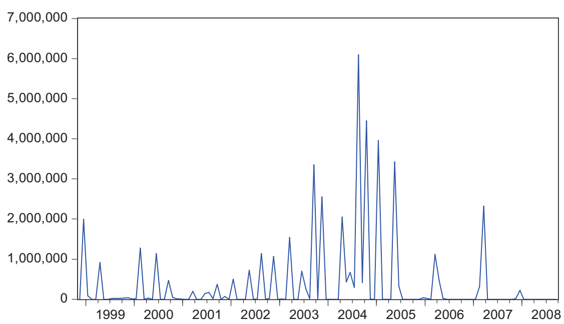
Descriptive Statistics - Malaysia

	EXRA	QMT	VALUE
Mean	3.707	16,971.780	8,090,816
Maximum	3.801	121,166.400	66,003,225
Minimum	3.160	0	0
Std. Dev.	0.174	21,527.570	10,423,356
Skewness	-1.788	2.468	2.647
Kurtosis	4.867	10.493	12.386
Jarque-Bera	80.679	399.198	575.704
Sum	441.189	2,019,641.000	9.63E+08
Sum Sq. Dev.	3.564	5.47E+10	1.28E+16
Observations	119	119	119

2.2.8.7 Philippines



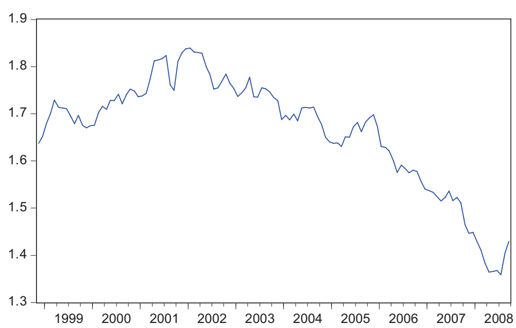


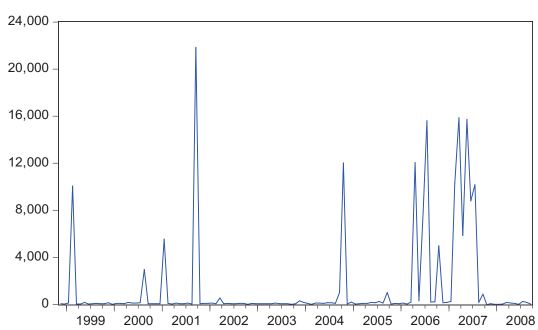


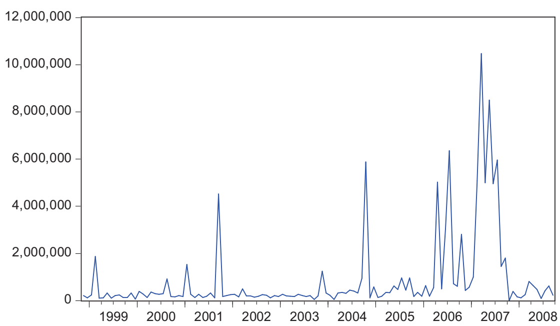
Descriptive Statistics - Philippines

	EXRA	QMT	VALUE
Mean	49.277	782	382,285
Maximum	56.471	10,213	6,092,125
Minimum	37.896	0	0
Std. Dev.	5.771	1,826.765	970,045.900
Skewness	-0.557	2.873	3.531
Kurtosis	1.985	11.366	16.575
Jarque-Bera	11.254	510.679	1,161.074
Sum	5,863.943	93,072.780	45,491,892
Sum Sq. Dev.	3,930.172	3.94E+08	1.11E+14
Observations	119	119	119

2.2.8.8 Singapore



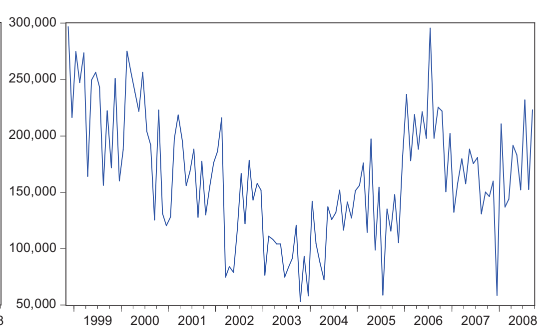


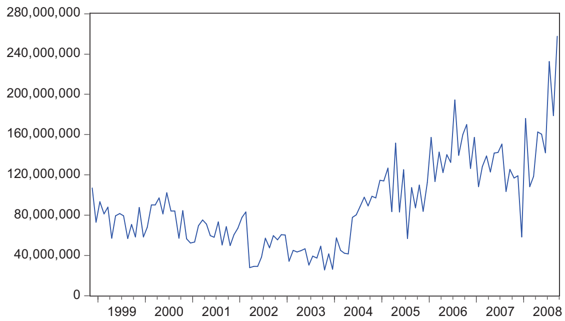


Descriptive Statistics - Singapore

	EXRA	QMT	VALUE
Mean	1.665	1,462.423	900,481
Maximum	1.839	21,854.110	10,464,861
Minimum	1.359	0	0
Std. Dev.	0.118	3,914.881	1,749,255
Skewness	-0.939	3.142	3.251
Kurtosis	3.243	12.568	13.896
Jarque-Bera	17.782	649.798	798.389
Sum	198.125	174,028.300	1.07E+08
Sum Sq. Dev.	1.646	1.81E+09	3.61E+14
Observations	119	119	119

2.2.8.9 South Korea

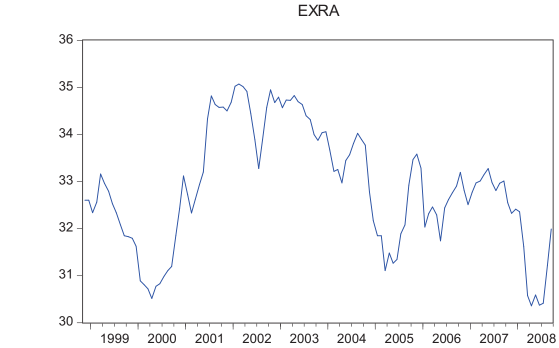


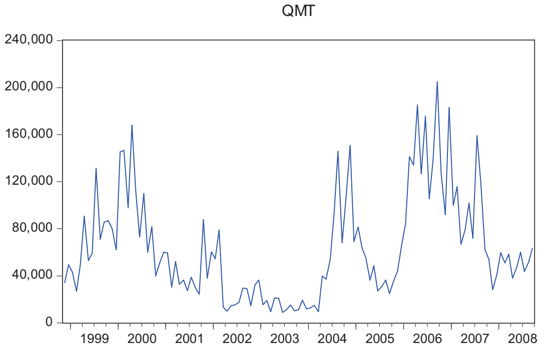


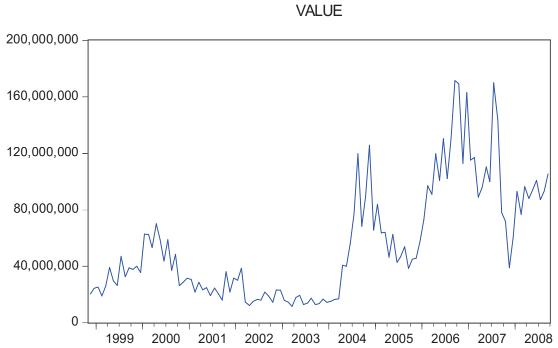
Descriptive Statistics - South Korea

	EXRA	QMT	VALUE
Mean	1,117.046	163,893	90,673,252
Maximum	1,327.760	297,042	257,000,000
Minimum	914.940	53,094.180	25,523,628
Std. Dev.	124.034	55,653.840	44,173,697
Skewness	-0.146	0.197	0.979
Kurtosis	1.795	2.522	4.147
Jarque-Bera	7.620	1.897	25.520
Sum	132,928.500	19,503,252	1.08E+10
Sum Sq. Dev.	1,815,351.000	3.65E+11	2.30E+17
Observations	119	119	119

2.2.8.10 Taiwan



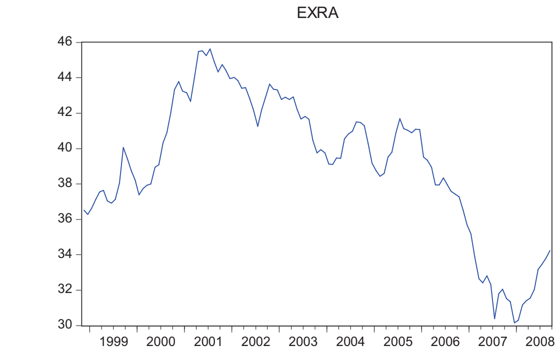


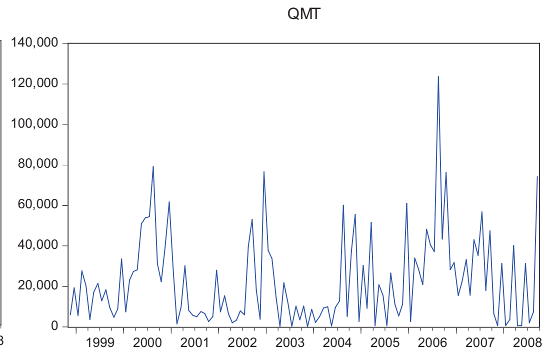


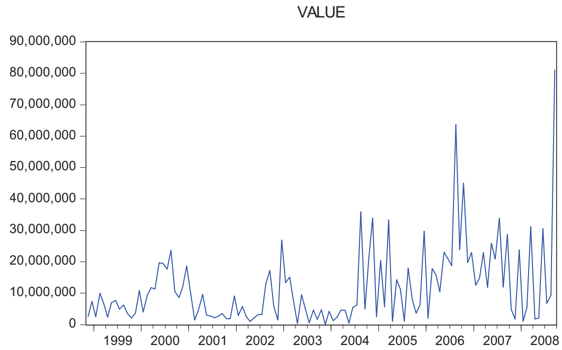
Descriptive Statistics - Taiwan

	EXRA	QMT	VALUE
Mean	32.875	64,120.420	55,620,519
Maximum	35.073	204,736.200	172,000,000
Minimum	30.356	8,757.973	11,572,937
Std. Dev.	1.275	45,358.320	40,223,636
Skewness	-0.085	1.031	1.017
Kurtosis	2.166	3.434	3.303
Jarque-Bera	3.589	22.006	20.962
Sum	3,912.079	7,630,330	6.62E+09
Sum Sq. Dev.	191.791	2.43E+11	1.91E+17
Observations	119	119	119

2.2.8.11 Thailand





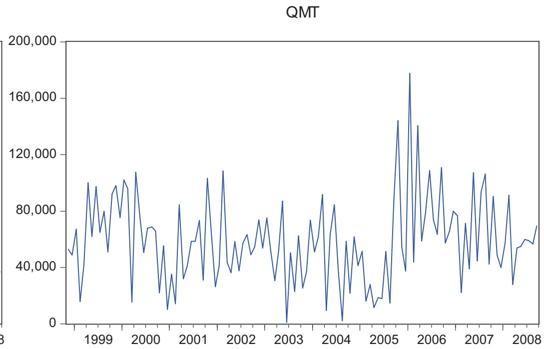


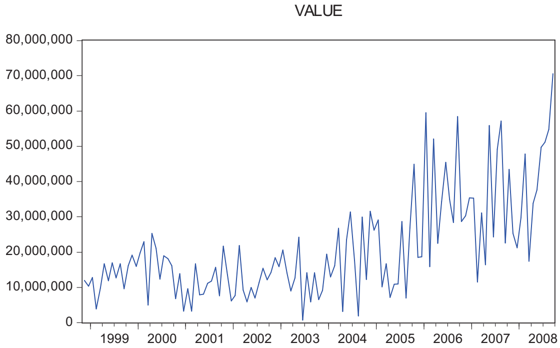
Descriptive Statistics - Thailand

	EXRA	QMT	VALUE
Mean	39.140	22,473.170	11,697,711
Maximum	45.641	123,611.900	80,970,542
Minimum	30.158	108.290	130,001
Std. Dev.	3.980	21,739.250	12,531,325
Skewness	-0.575	1.525	2.434
Kurtosis	2.535	6.132	11.671
Jarque-Bera	7.625	94.762	490.234
Sum	4,657.635	2,674,308.000	1.39E+09
Sum Sq. Dev.	1,869.260	5.58E+10	1.85E+16
Observations	119	119	119

2.2.9 Oceania

2.2.9.1 Australia

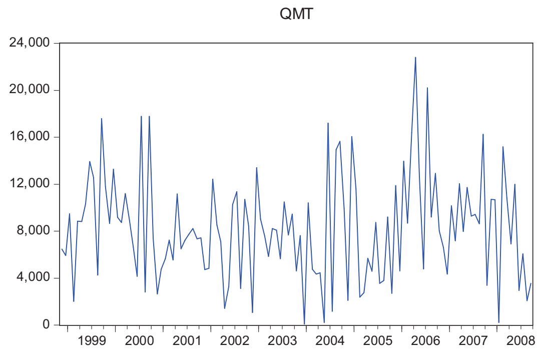


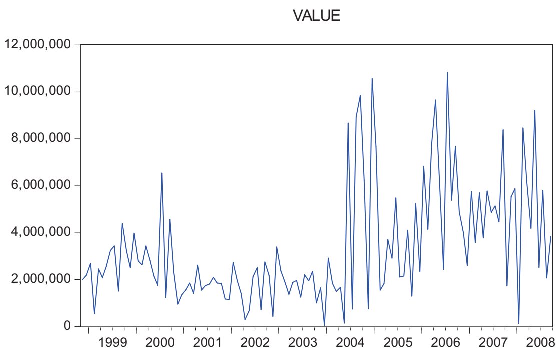


Descriptive Statistics - Australia

	EXRA	QMT	VALUE
Mean	1.500	59,195	20,973,544
Maximum	1.997	177,690.100	70,639,513
Minimum	1.039	1,202.959	707,283
Std. Dev.	0.267	30,476.340	14,499,614
Skewness	0.281	0.721	1.249
Kurtosis	1.955	4.268	4.086
Jarque-Bera	6.983	18.283	36.802
Sum	178.558	7,044,206	2.50E+09
Sum Sq. Dev.	8.424	1.10E+11	2.48E+16
Observations	119	119	119

2.2.9.2 New Zealand





Descriptive Statistics - New Zealand

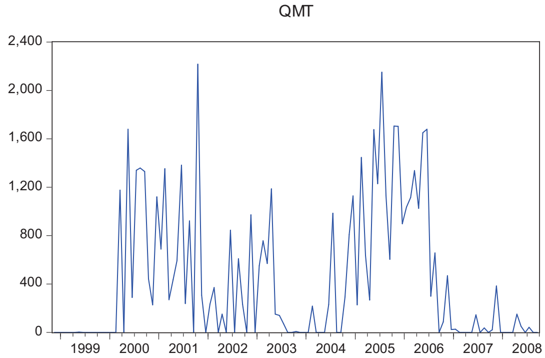
	EXRA	QMT	VALUE
Mean	1.766	8,282.305	3,369,090
Maximum	2.508	22,792.470	10,830,014
Minimum	1.250	75.200	55,206
Std. Dev.	0.375	4,531.623	2,463,021
Skewness	0.473	0.549	1.204
Kurtosis	1.905	3.180	3.784
Jarque-Bera	10.388	6.138	31.806
Sum	210.138	985,594.300	4.01E+08
Sum Sq. Dev.	16.625	2.42E+09	7.16E+14
Observations	119	119	119

2.3 Graphical Display of U.S. Steel Exports per Category

2.3.1 European Union

2.3.1.1 Belgium

1A



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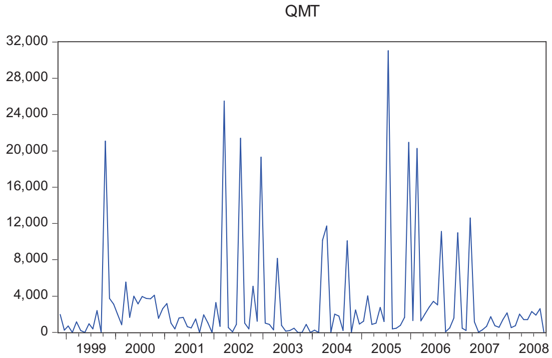

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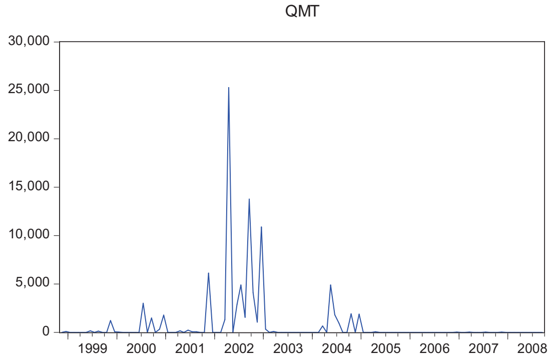

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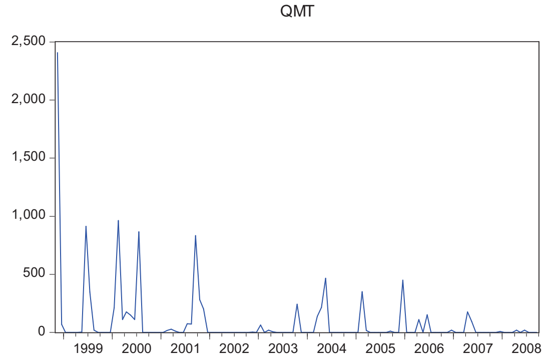

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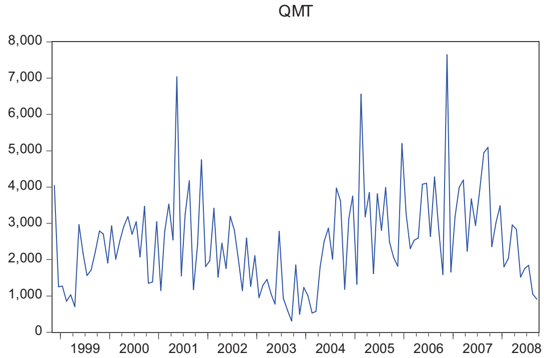

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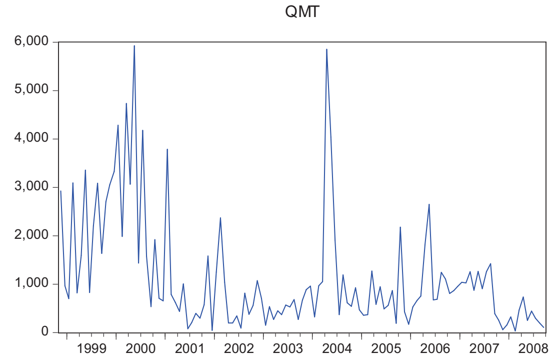

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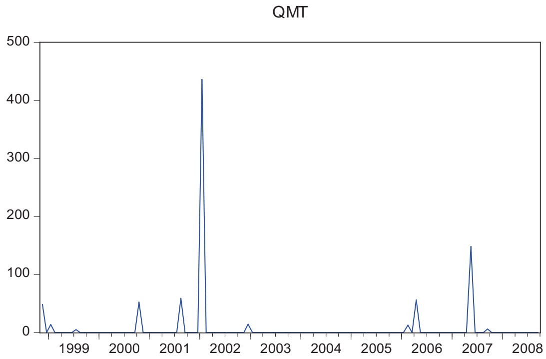

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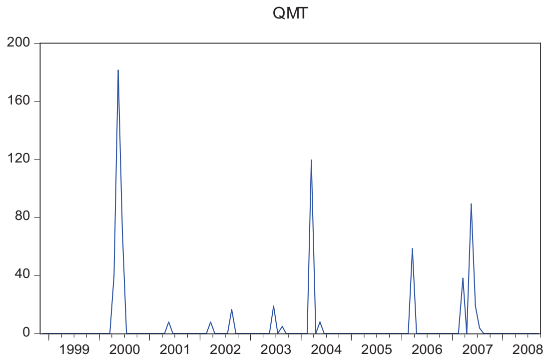

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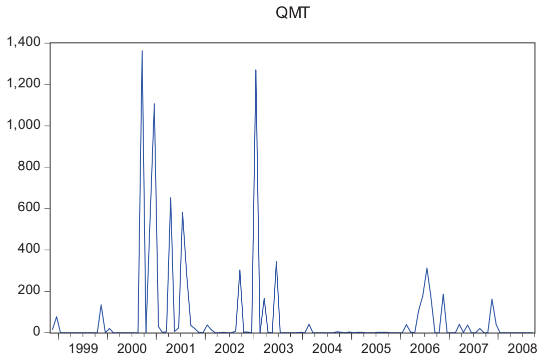

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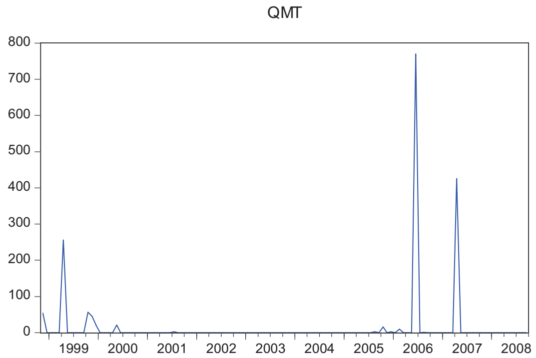

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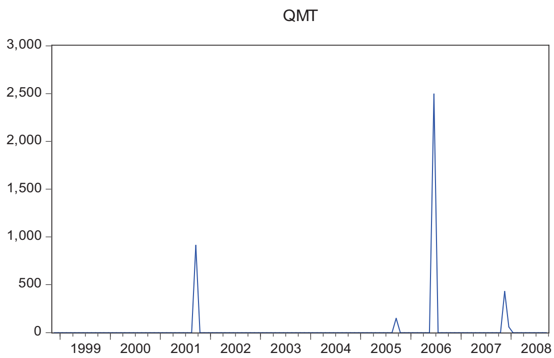

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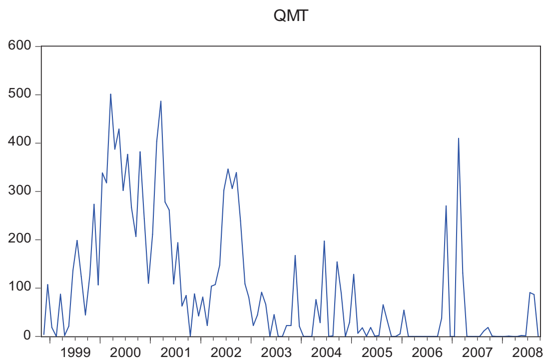

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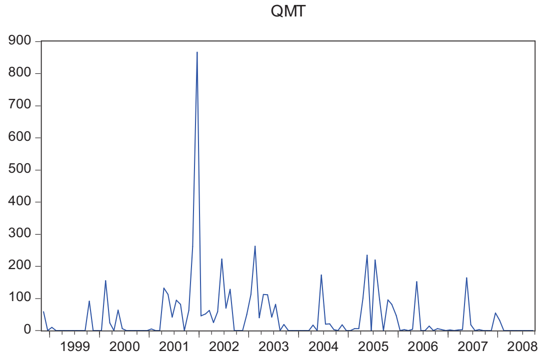

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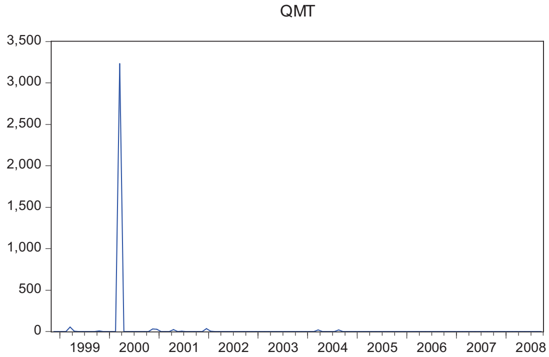

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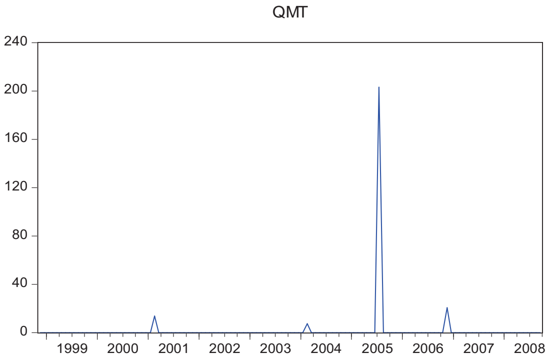

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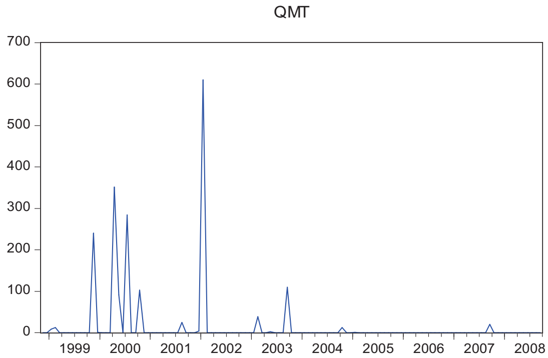

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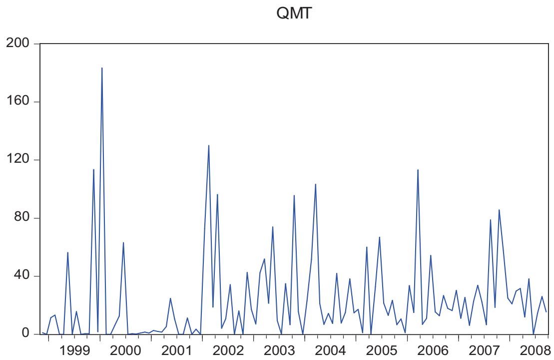

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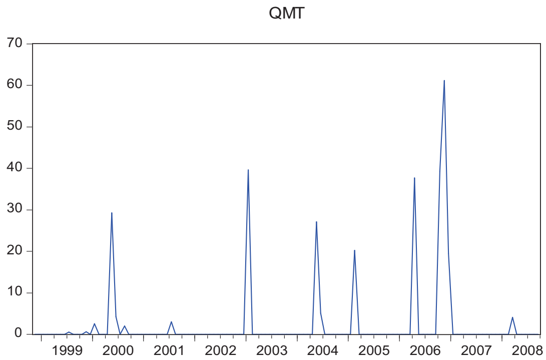

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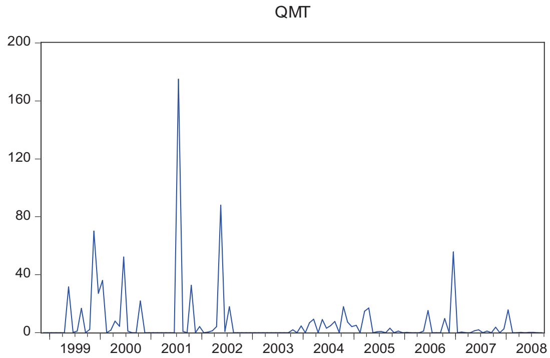

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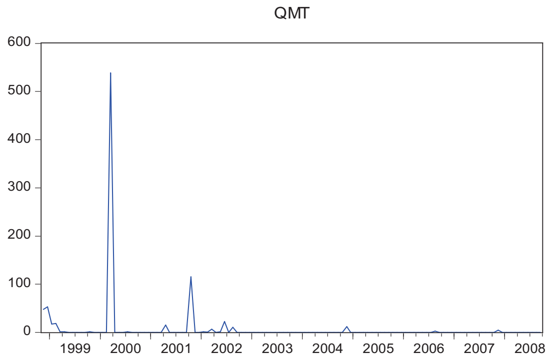

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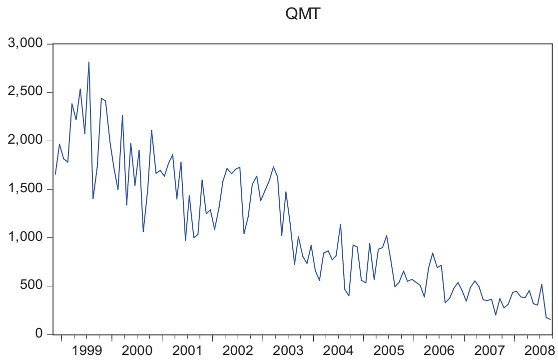

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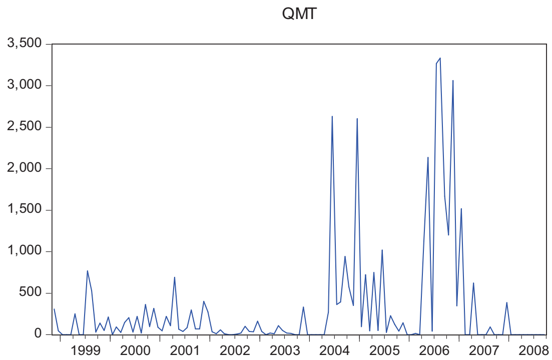

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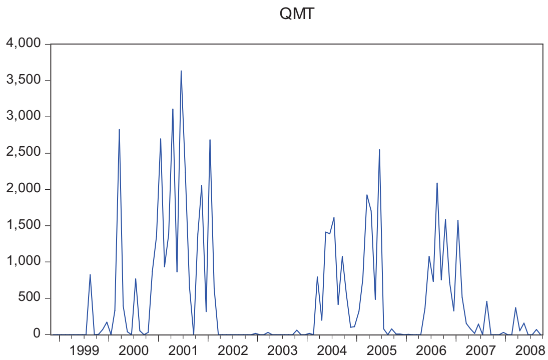

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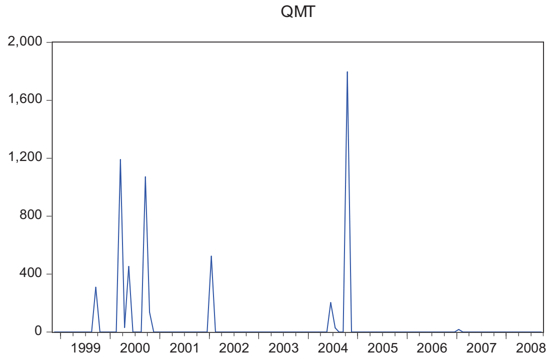

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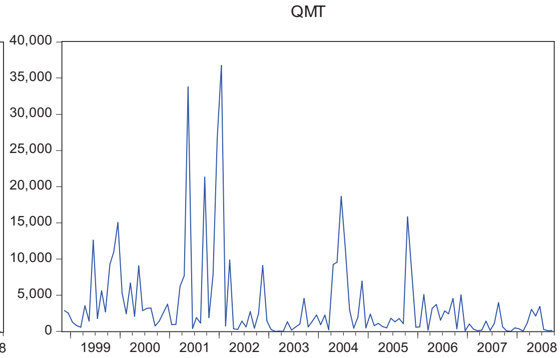

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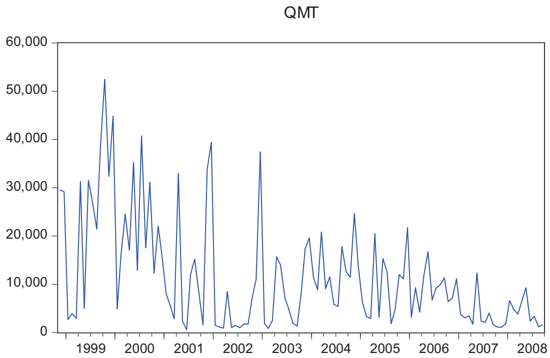

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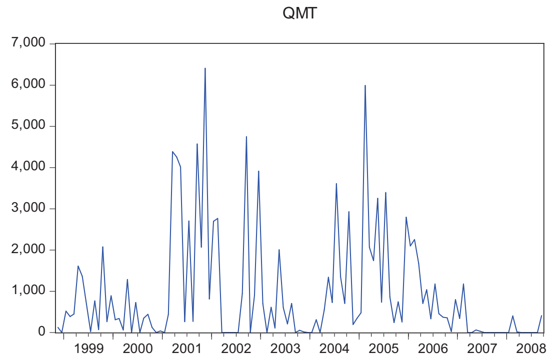

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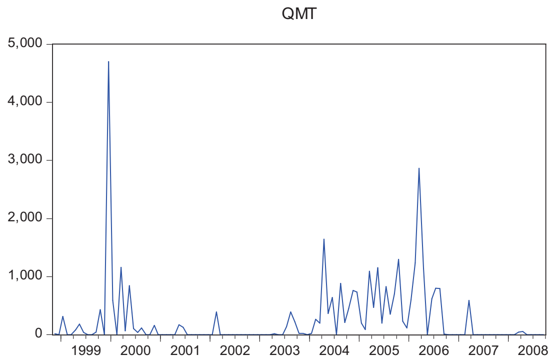

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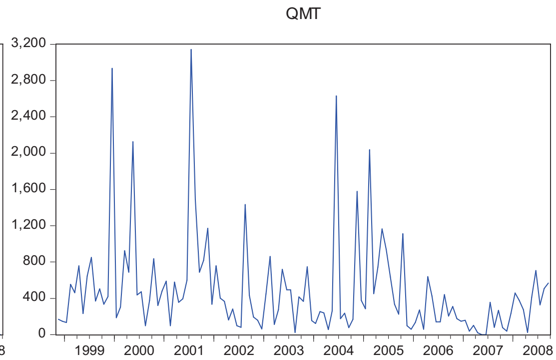

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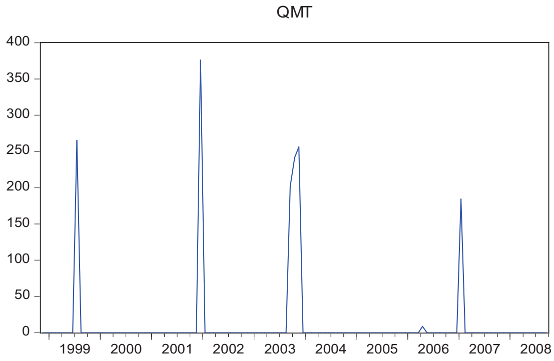

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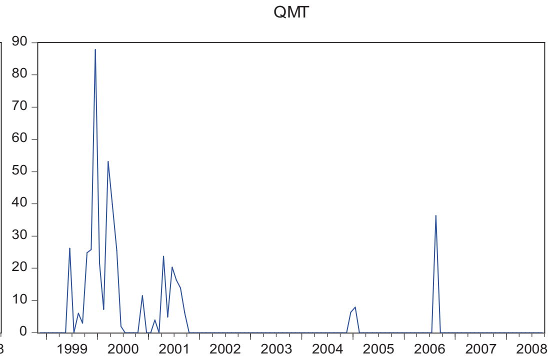

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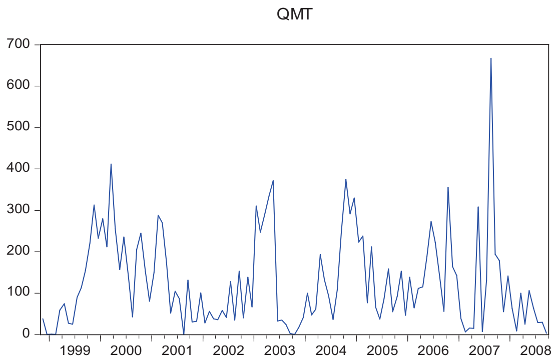

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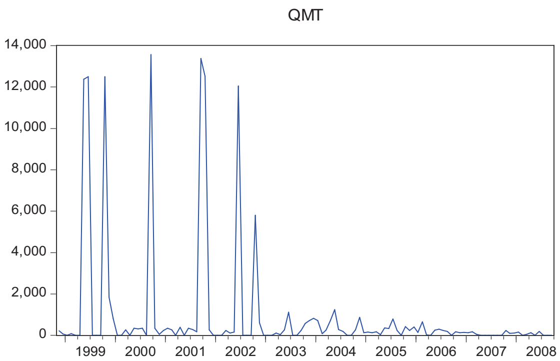

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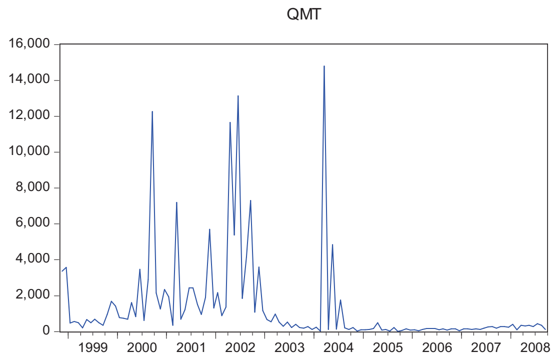
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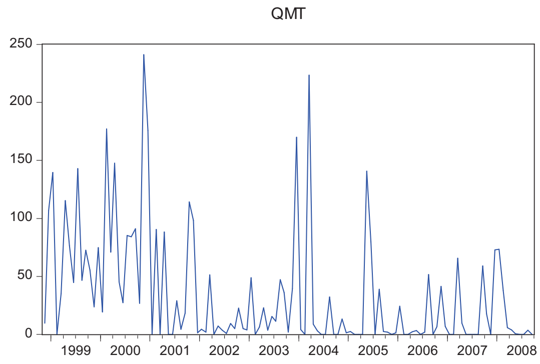
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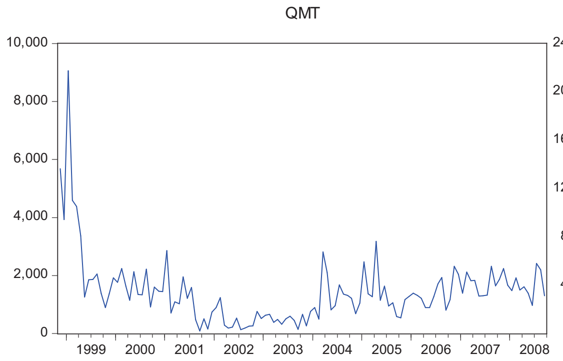
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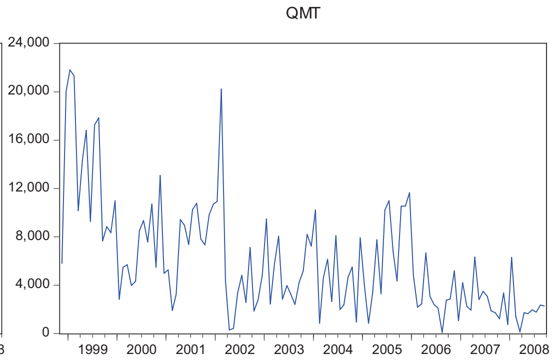
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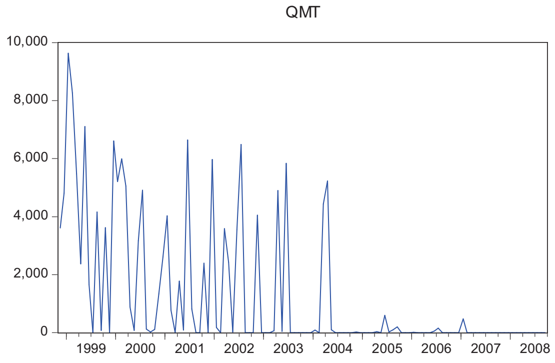
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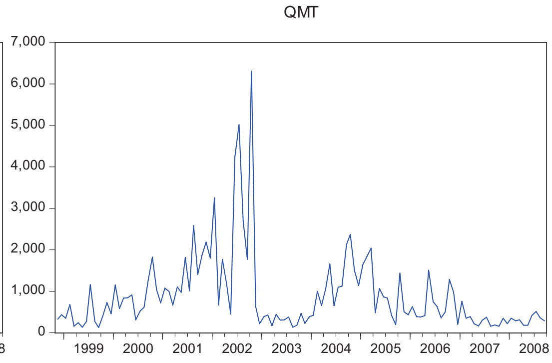
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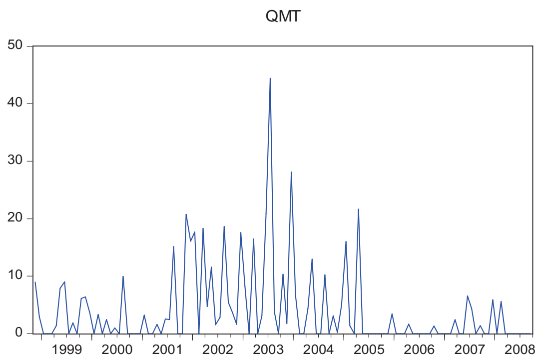

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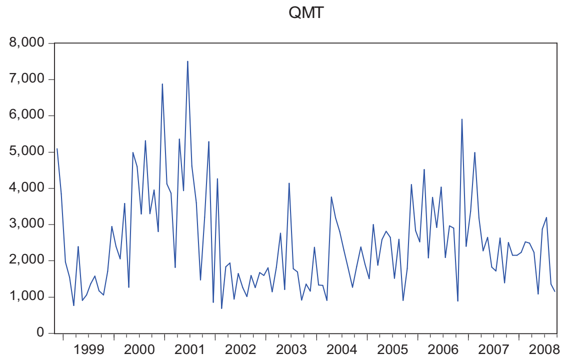

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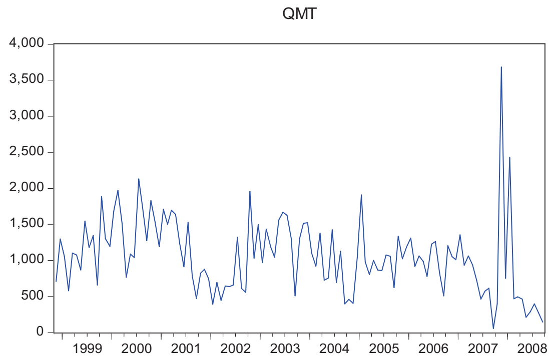

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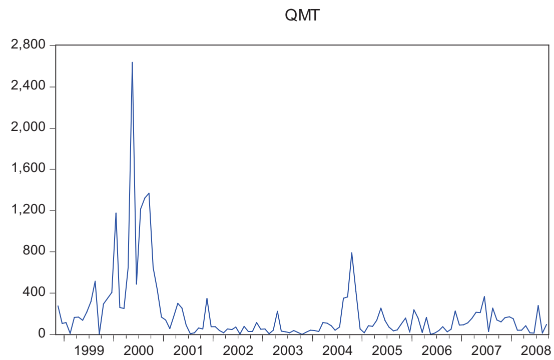

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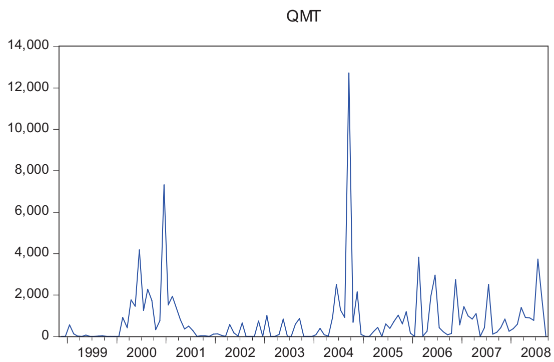

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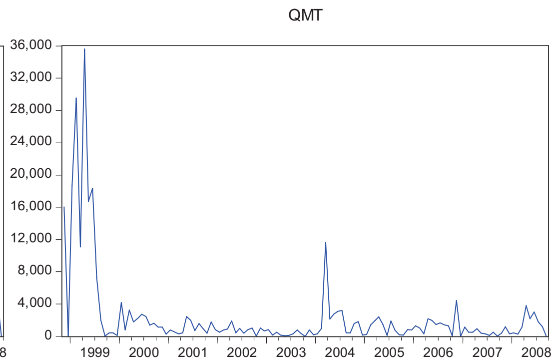

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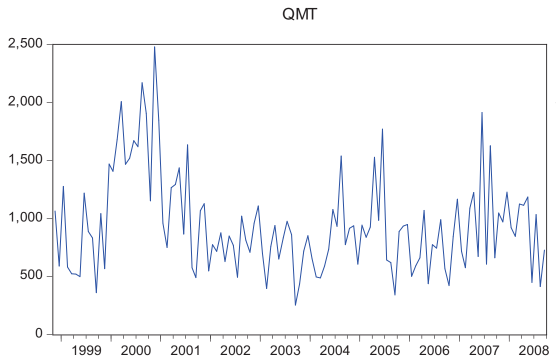

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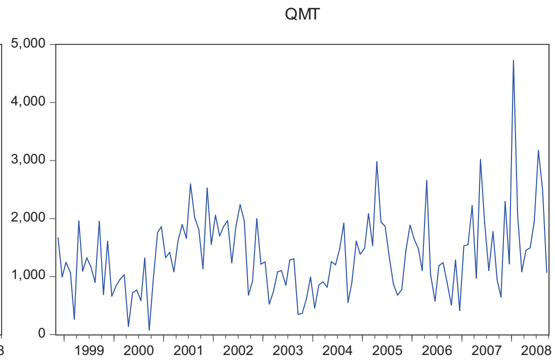

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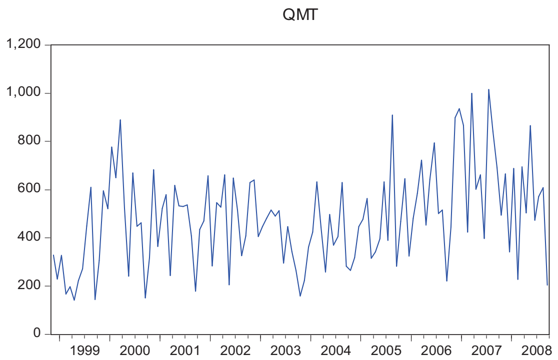

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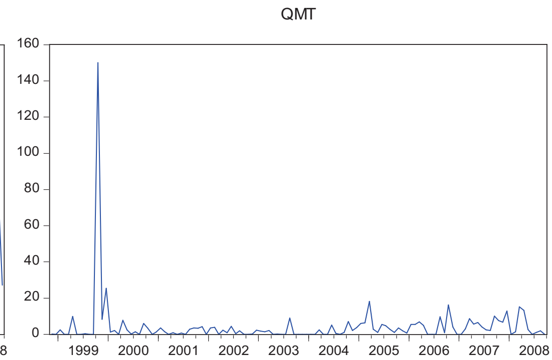

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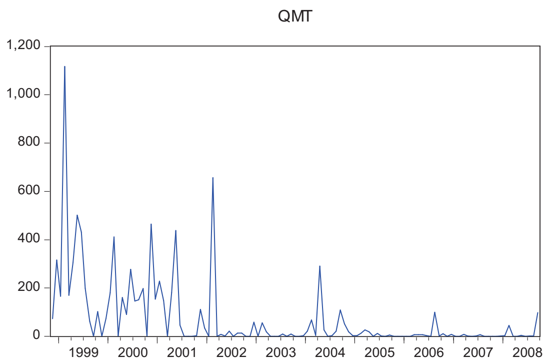

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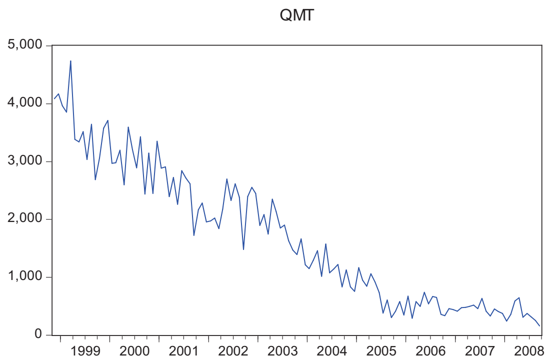

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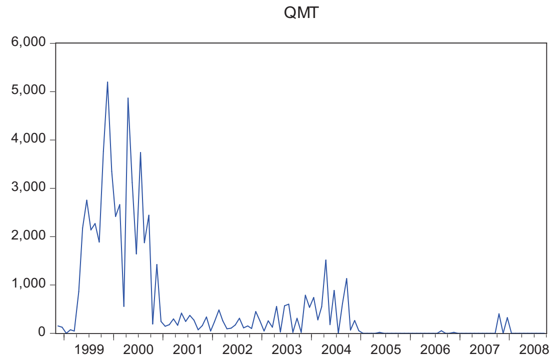

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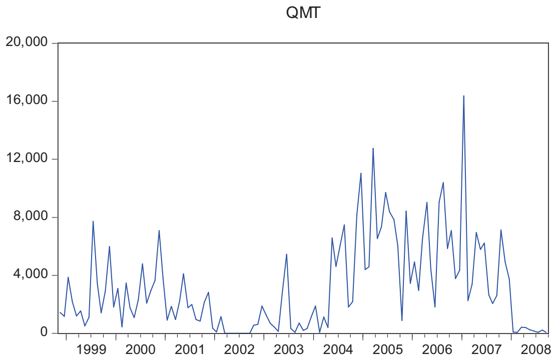

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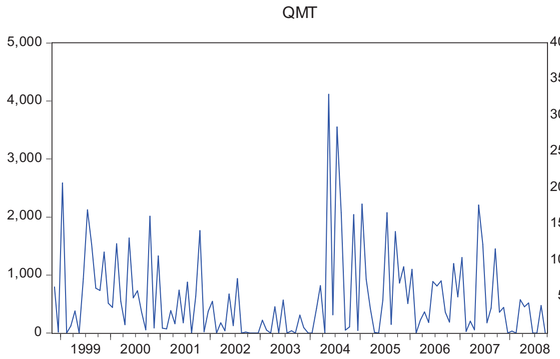

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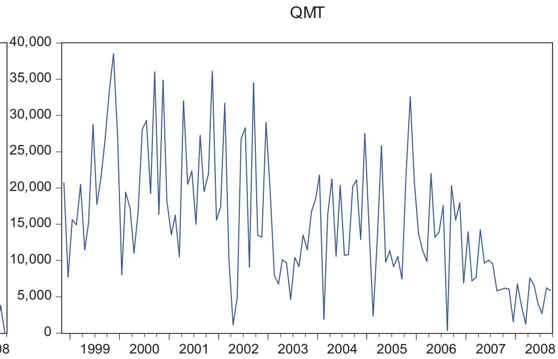

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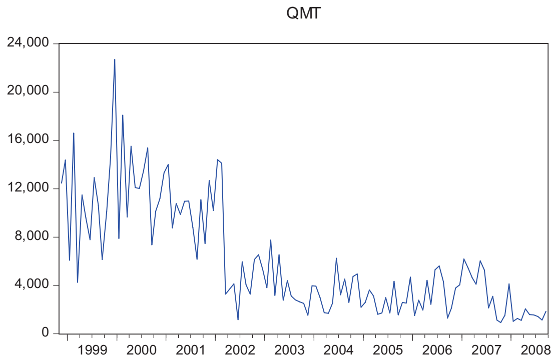

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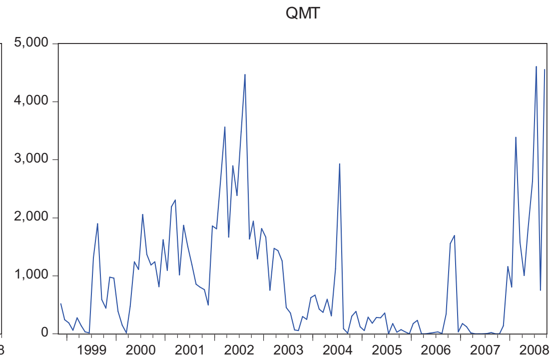

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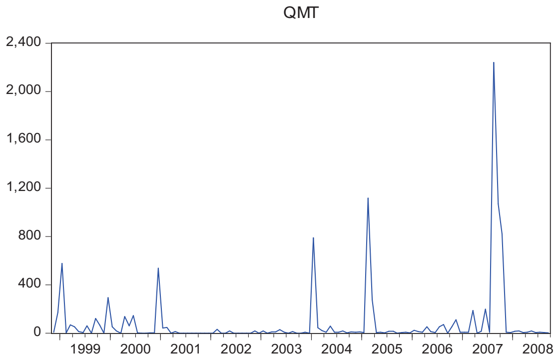
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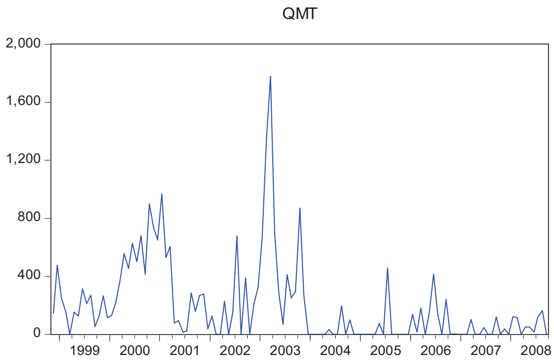
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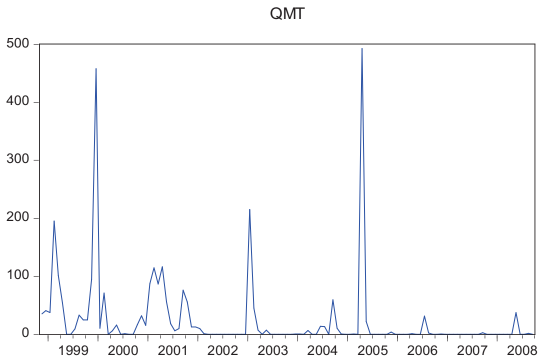
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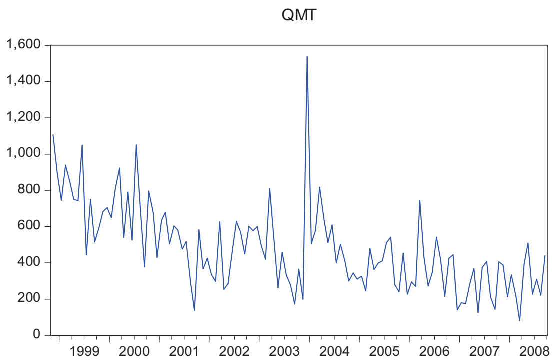
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2.3.1.3 Germany

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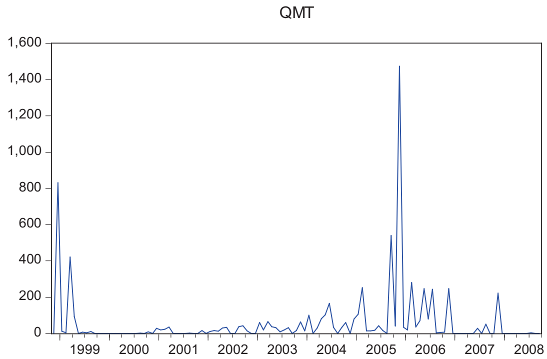

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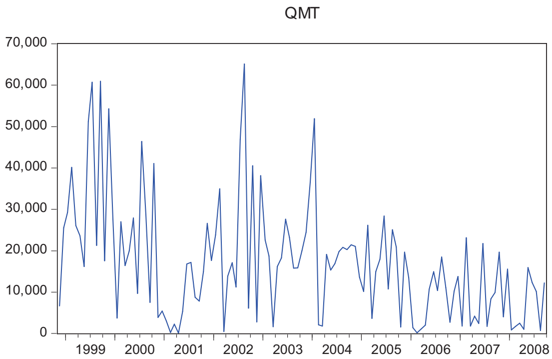

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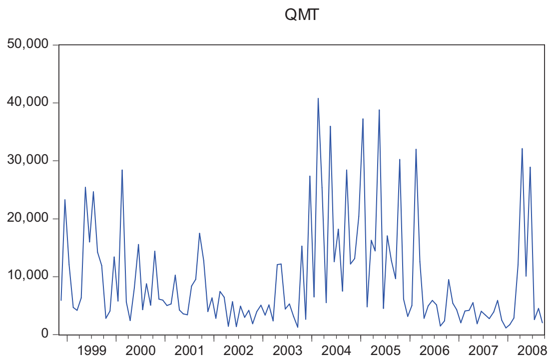

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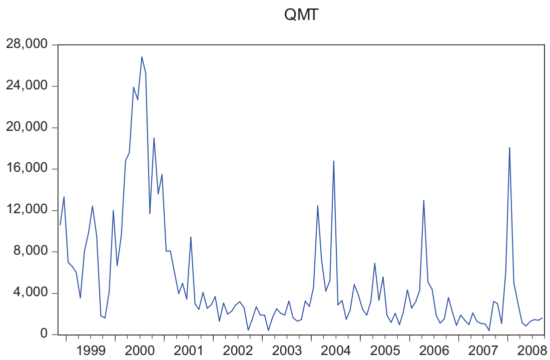

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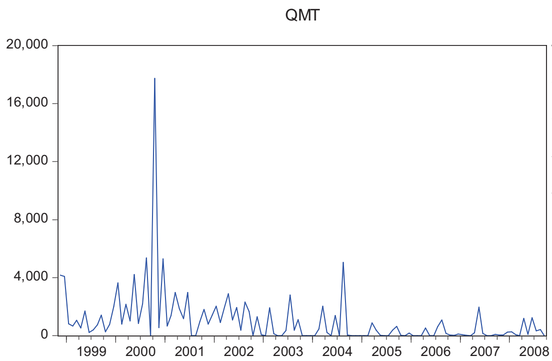

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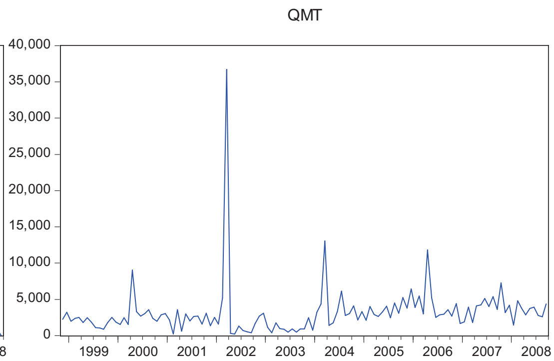

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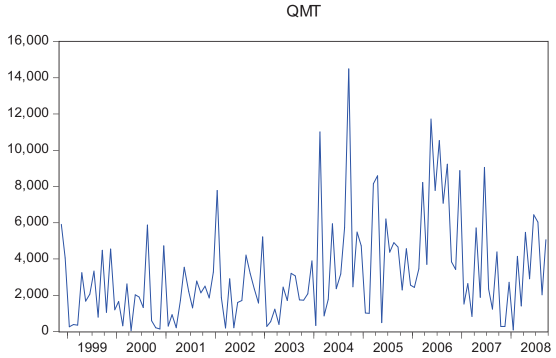
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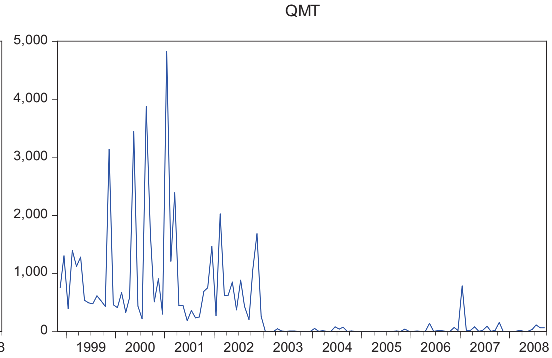
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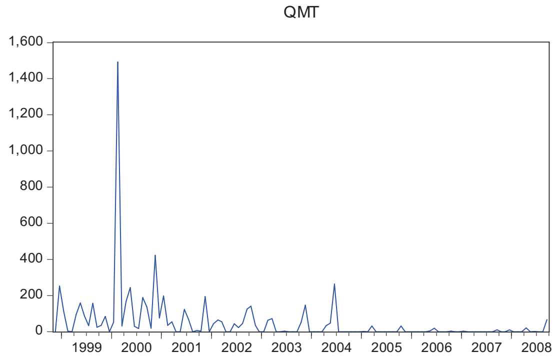
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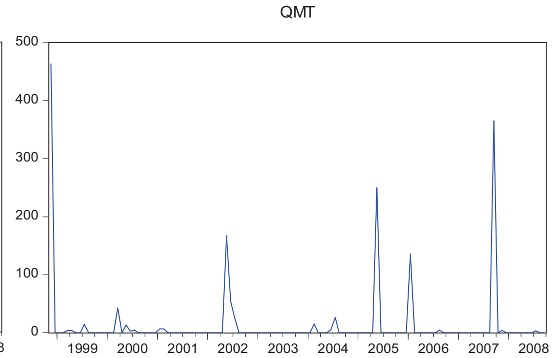
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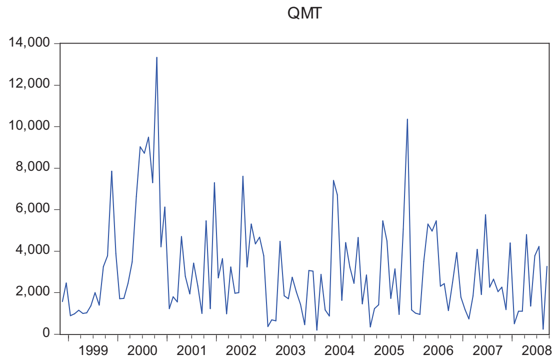
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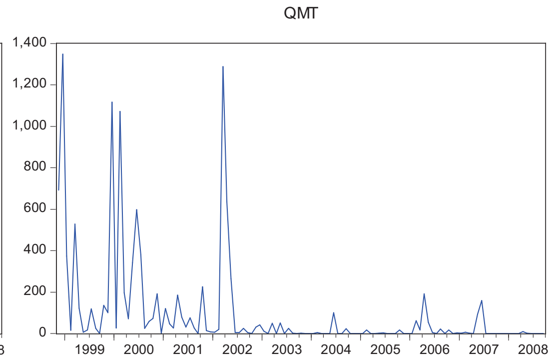
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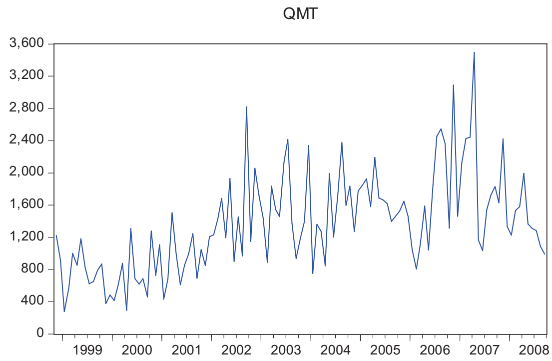

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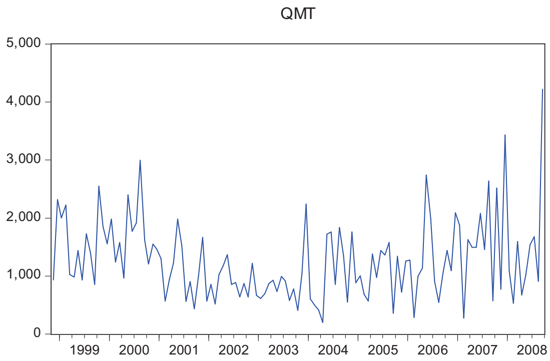

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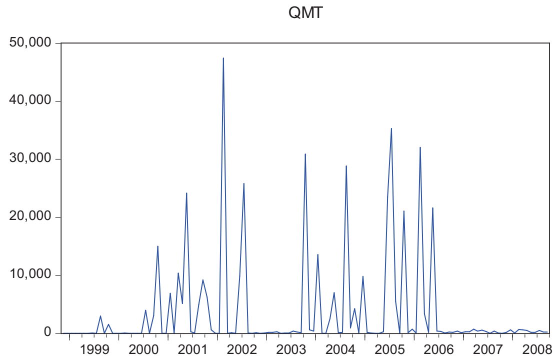

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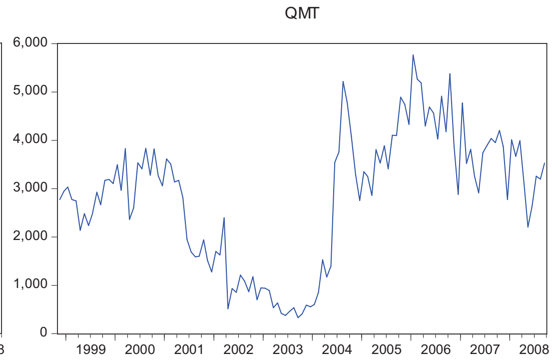

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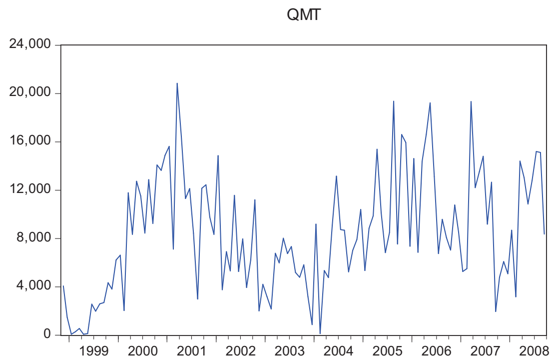

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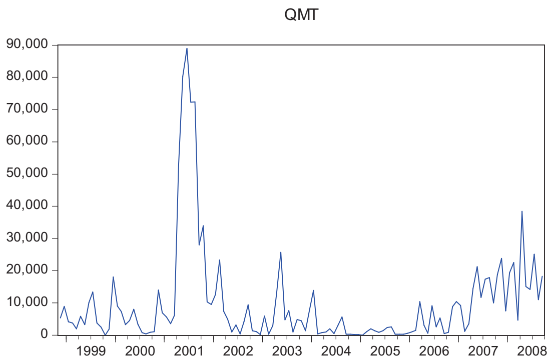

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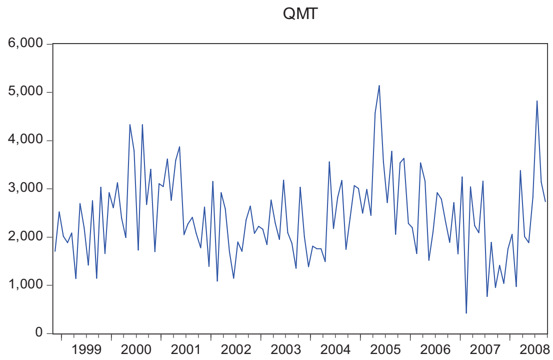

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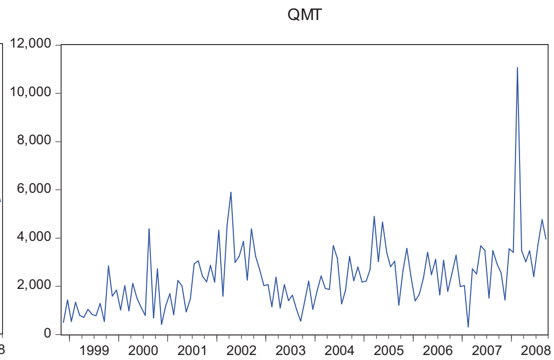

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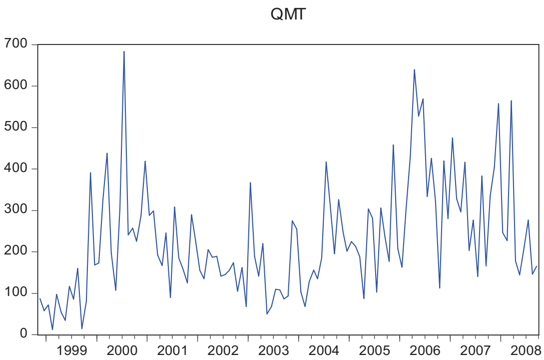

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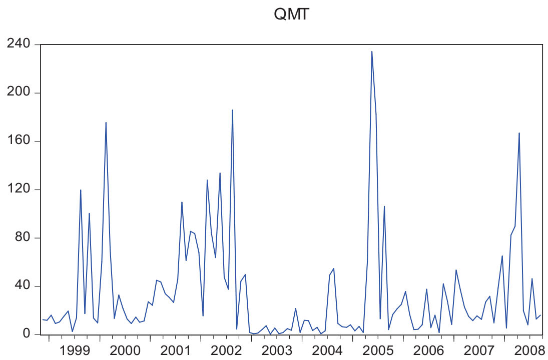

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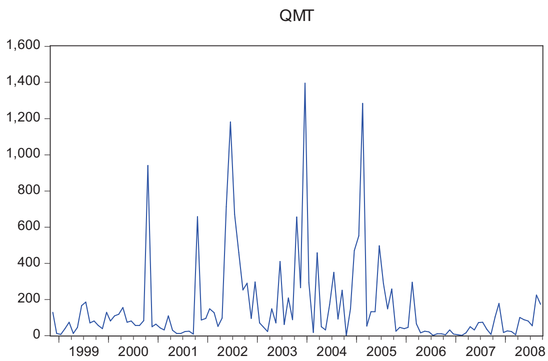

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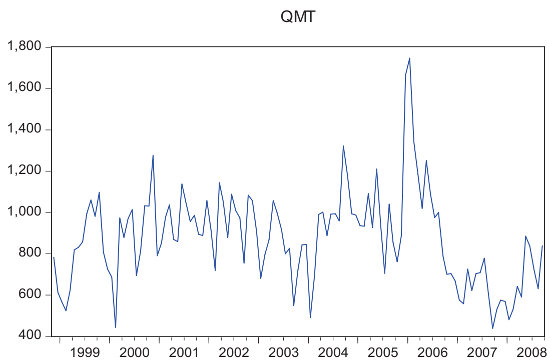

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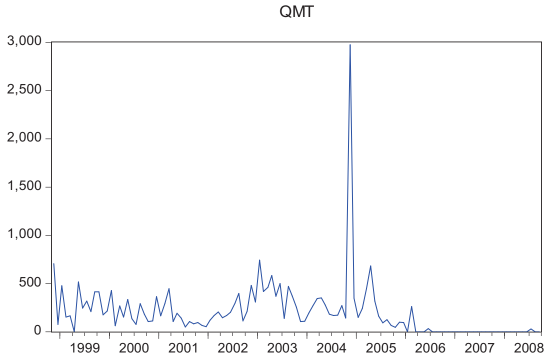

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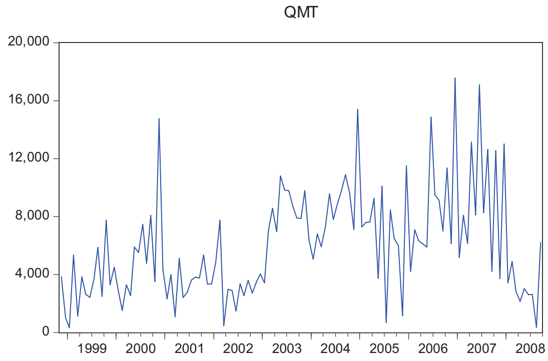

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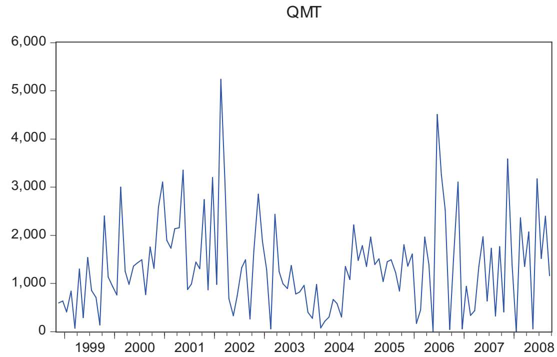

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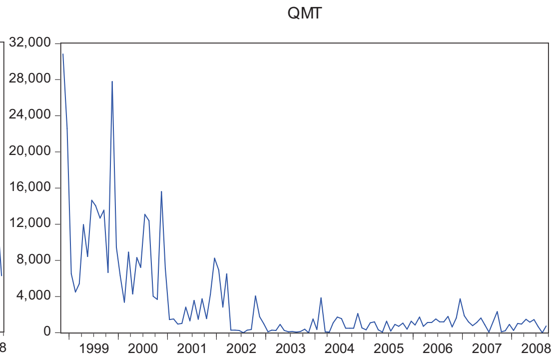

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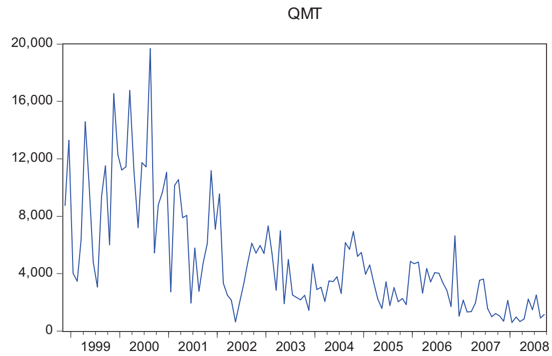

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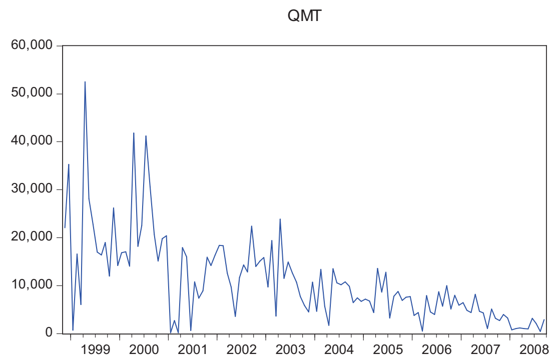

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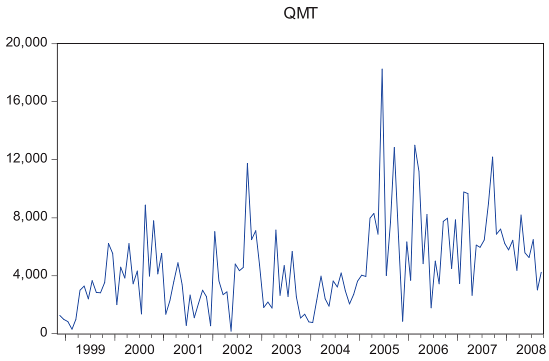

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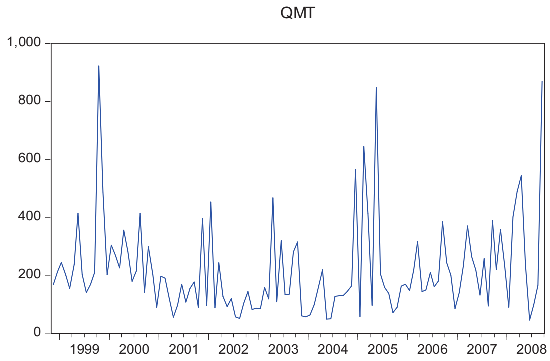

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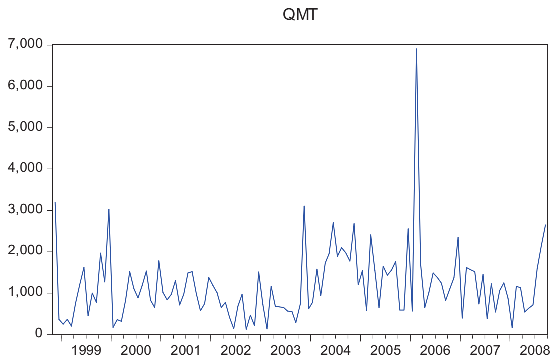

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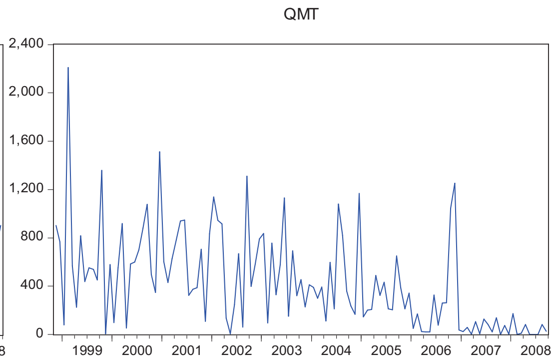

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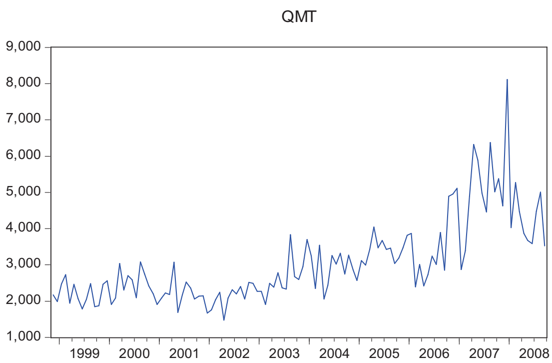

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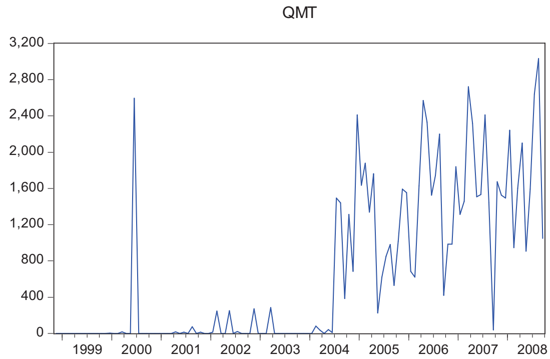

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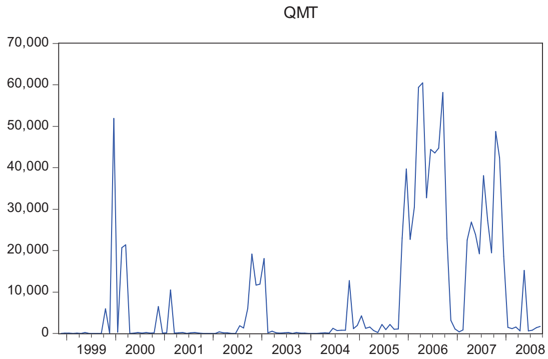

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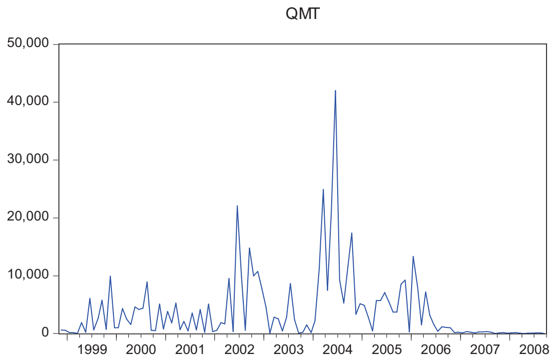

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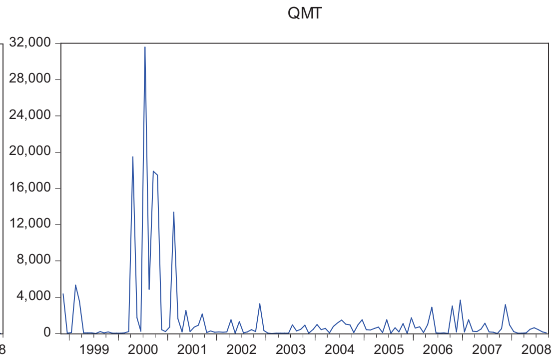

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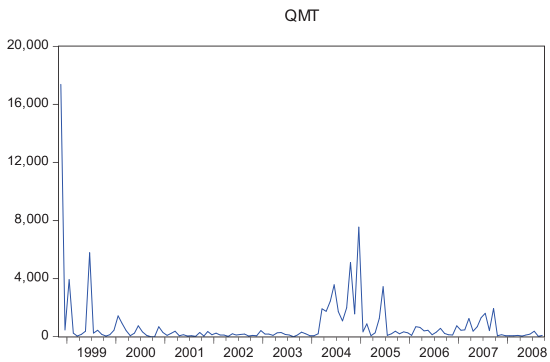

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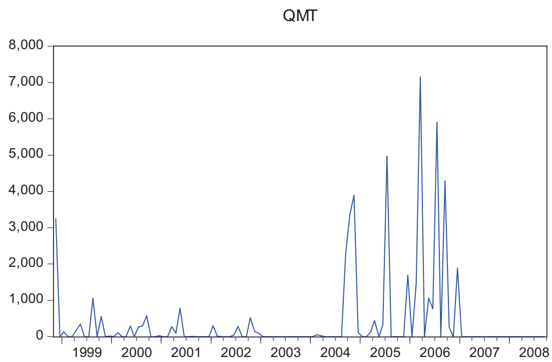

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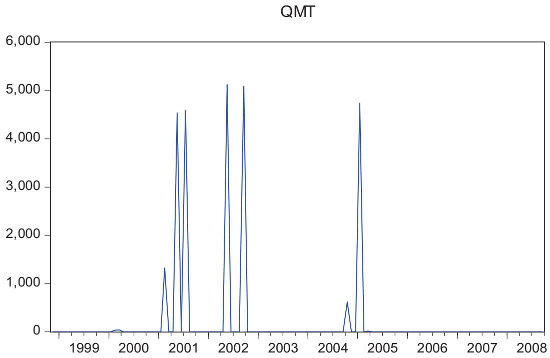

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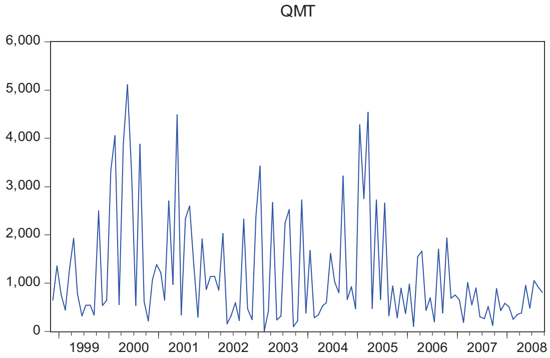

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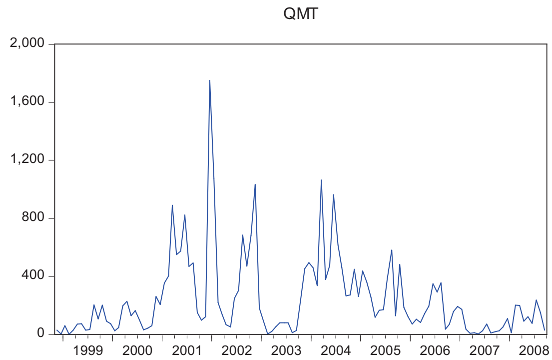

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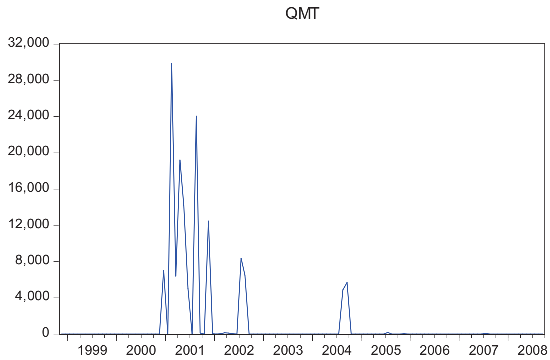

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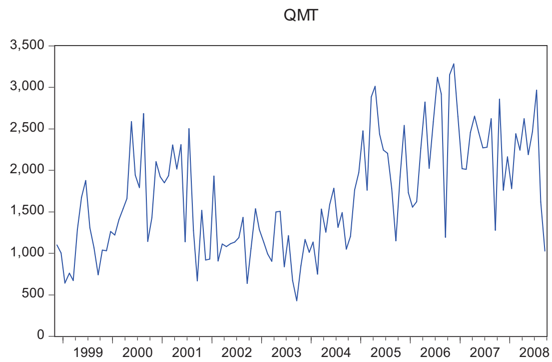

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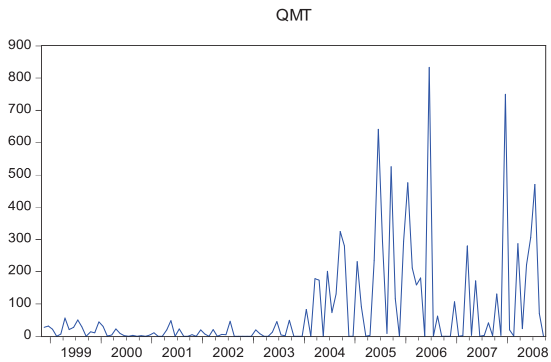

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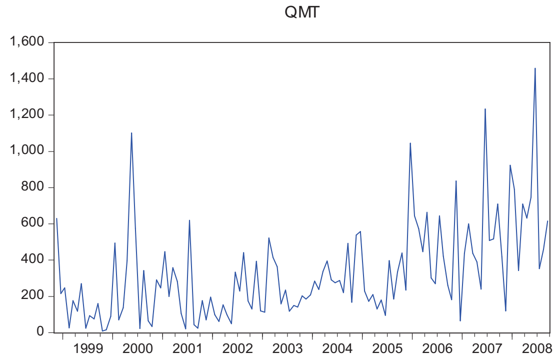

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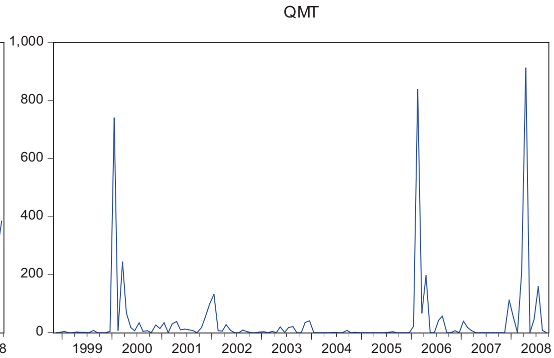

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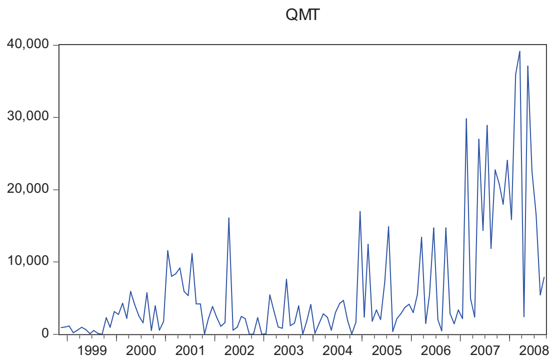

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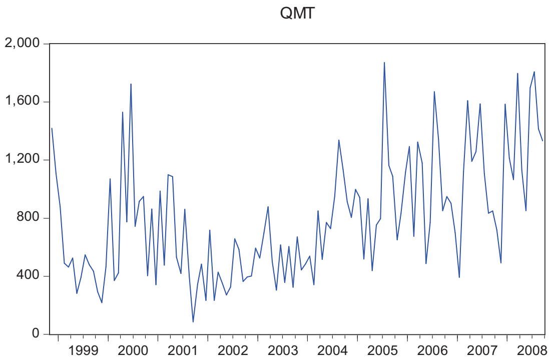

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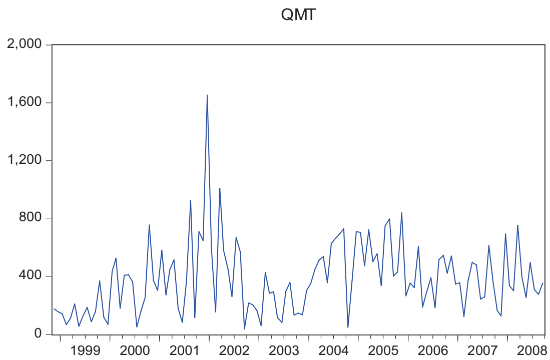

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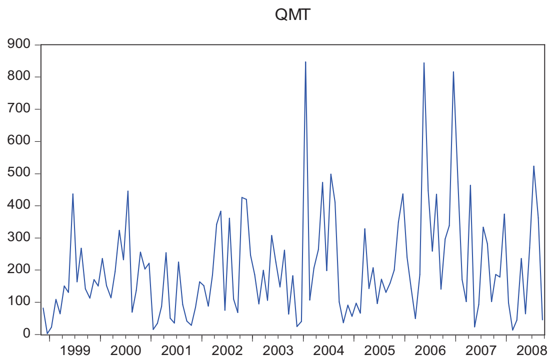

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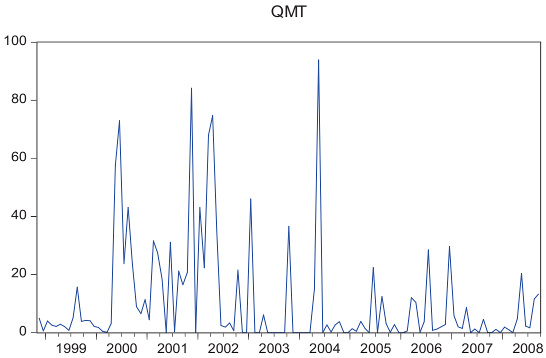

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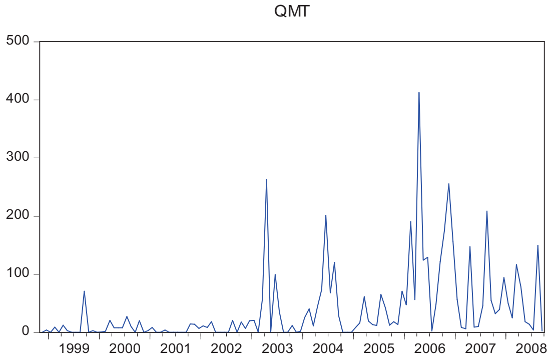

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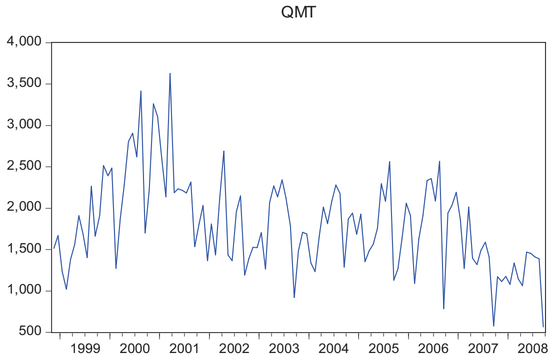

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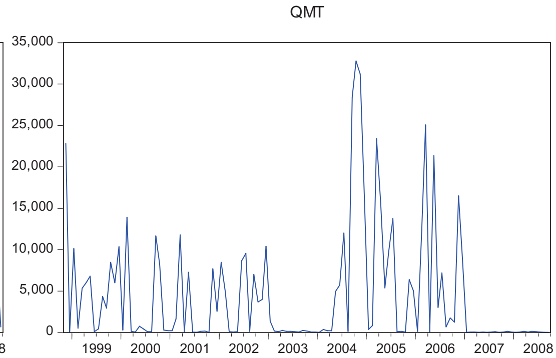

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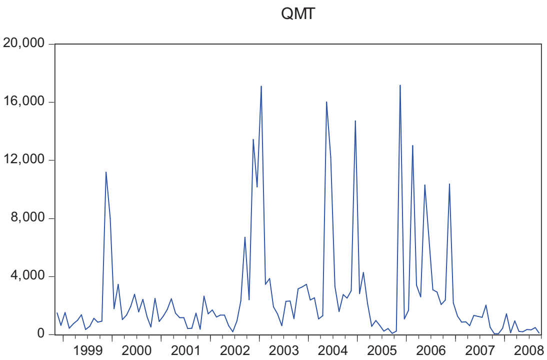

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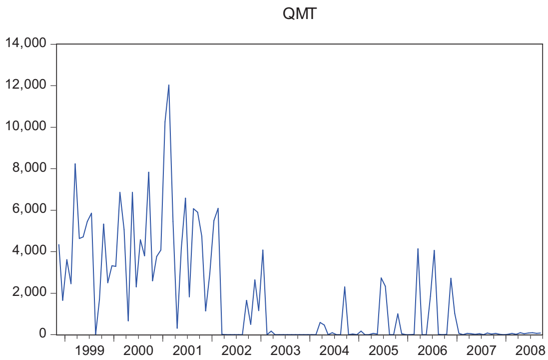

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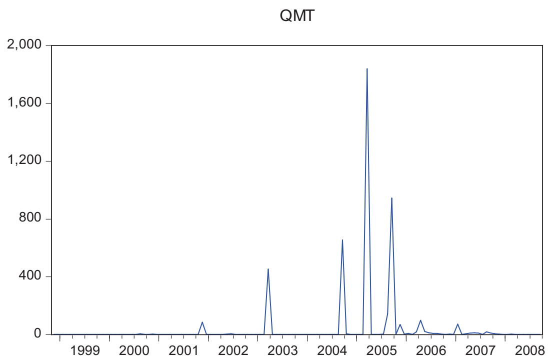

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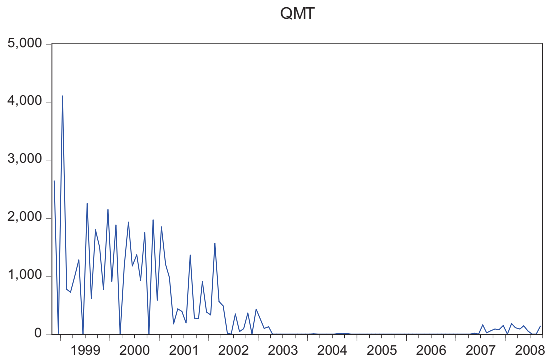

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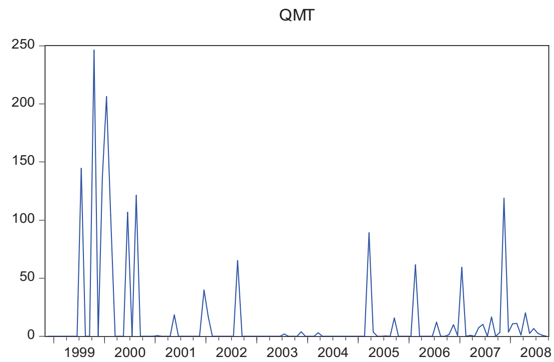

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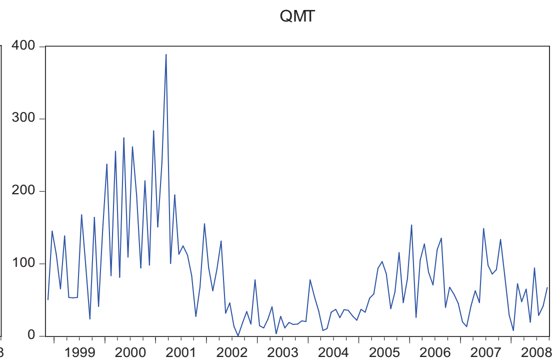

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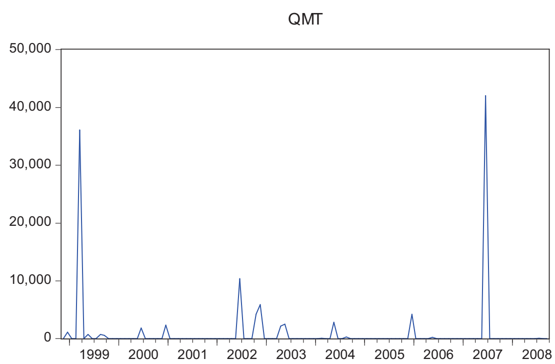

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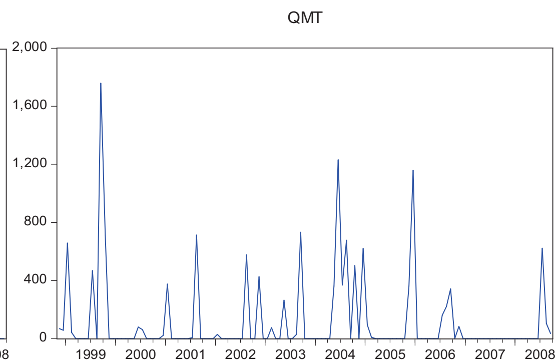

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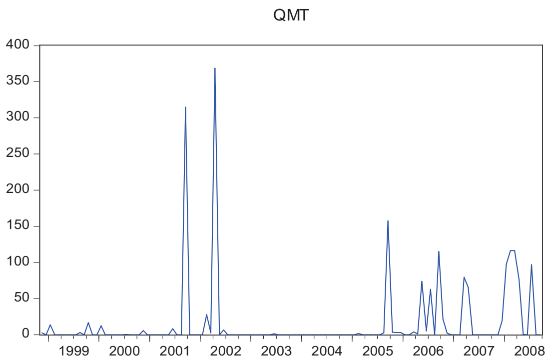

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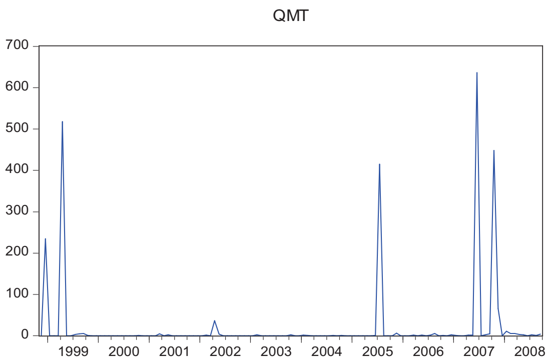

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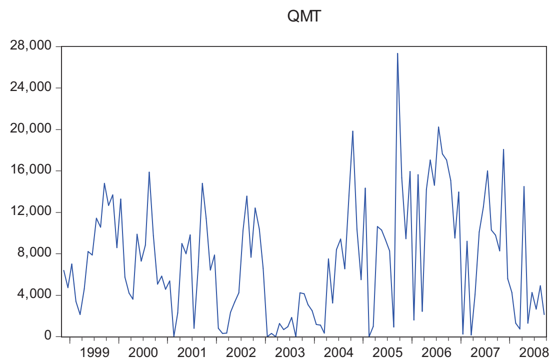

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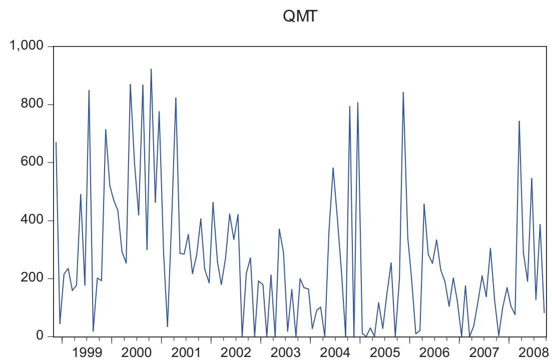

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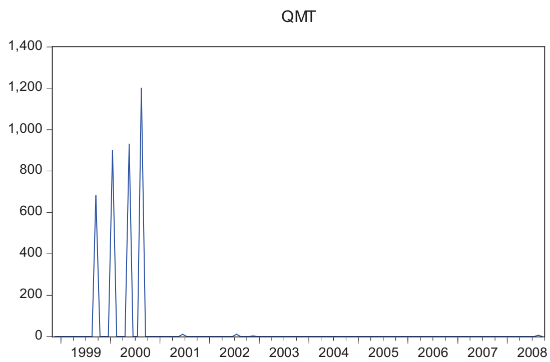

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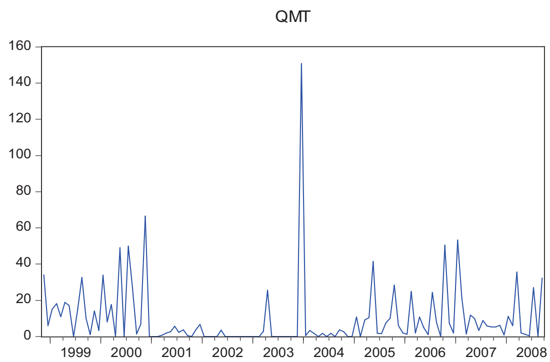

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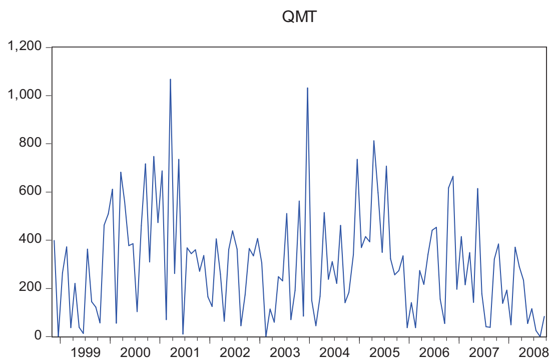

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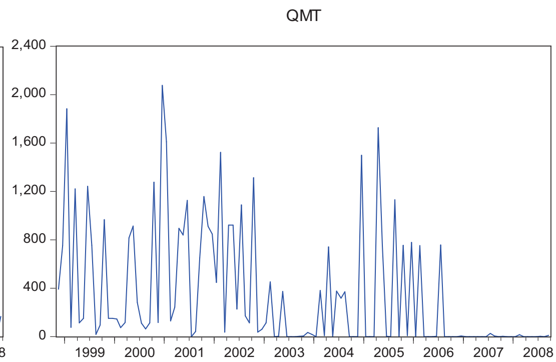

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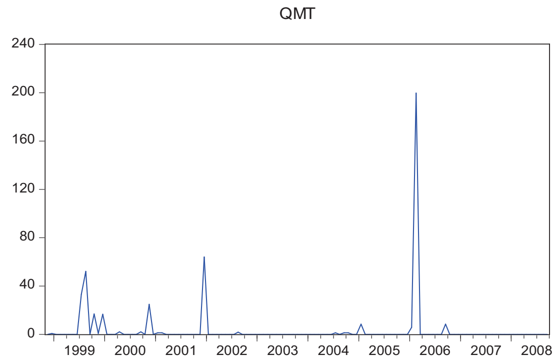

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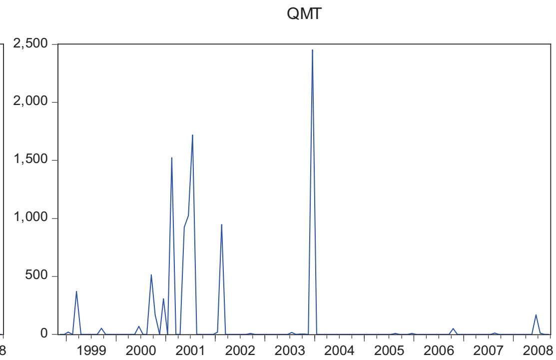

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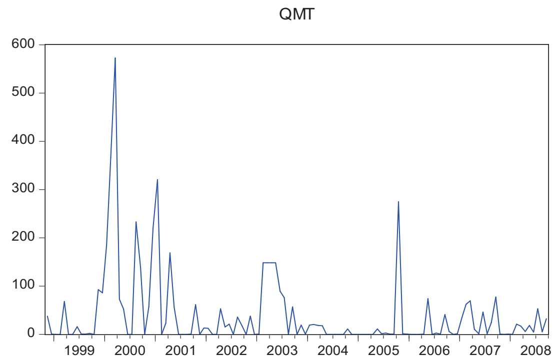

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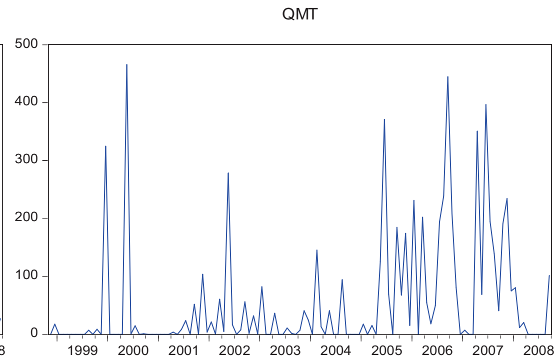

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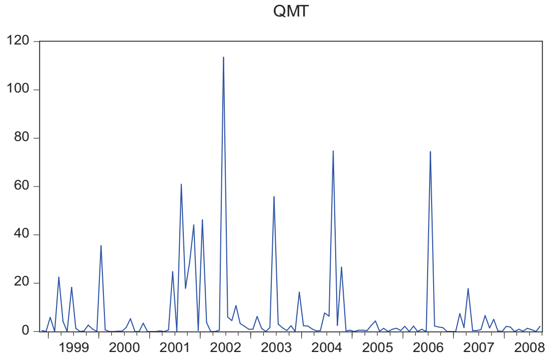

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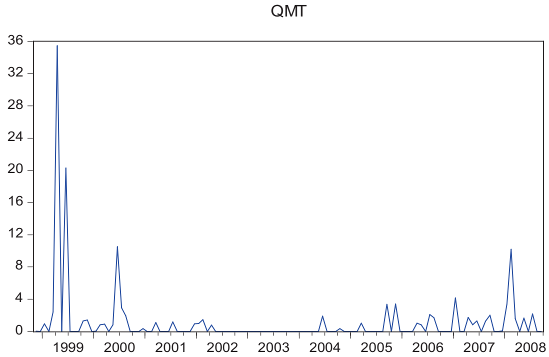

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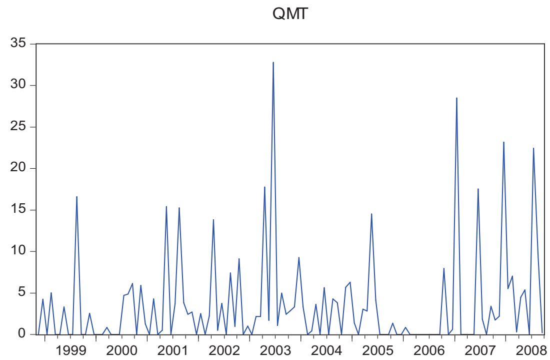

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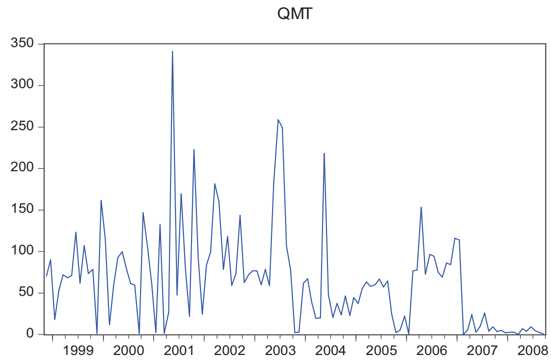

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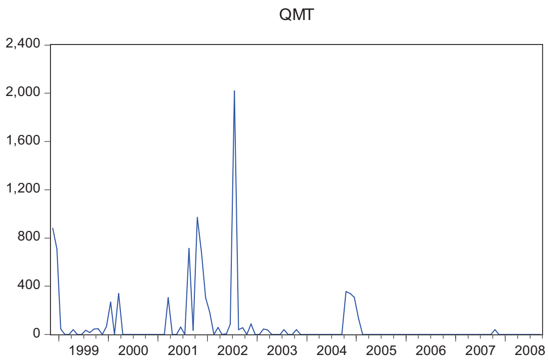

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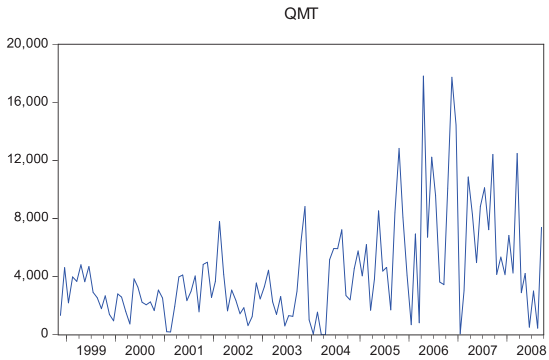

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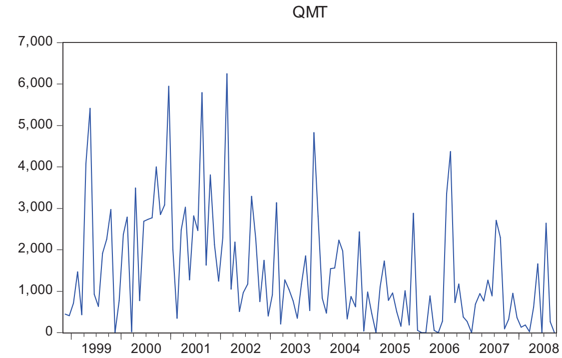

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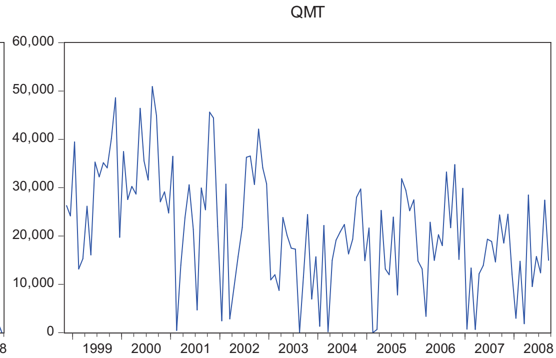

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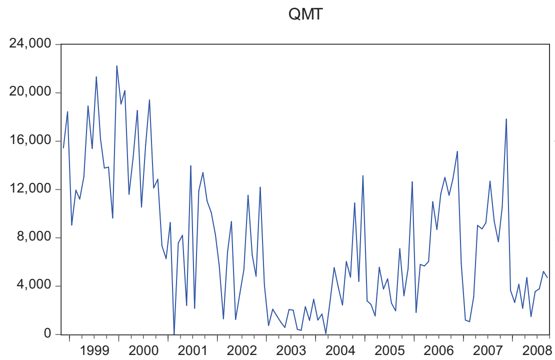

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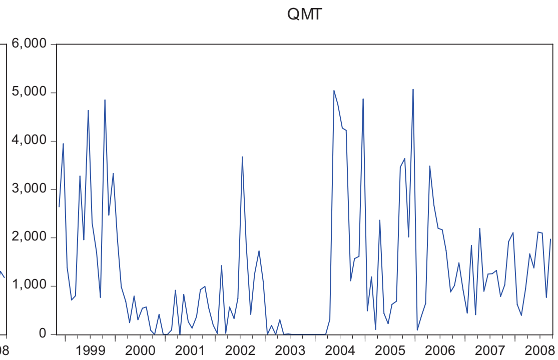

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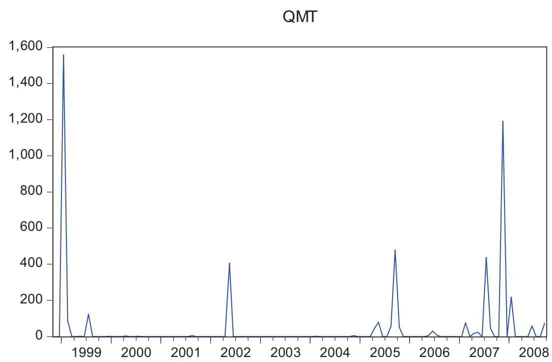

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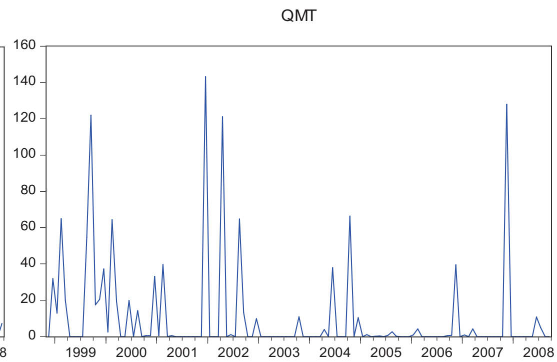

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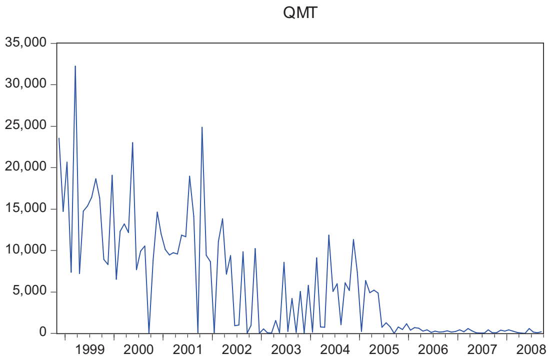

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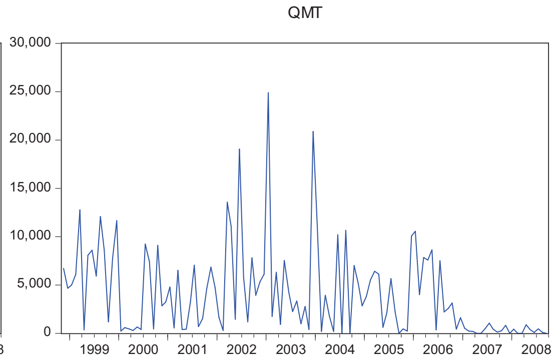

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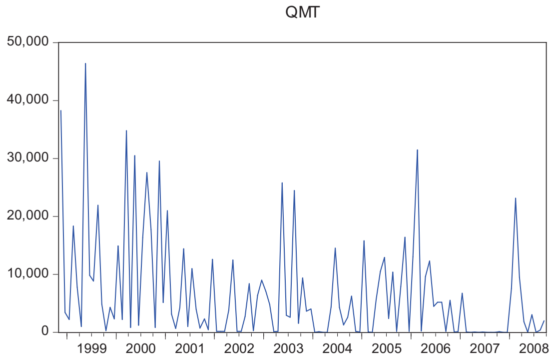

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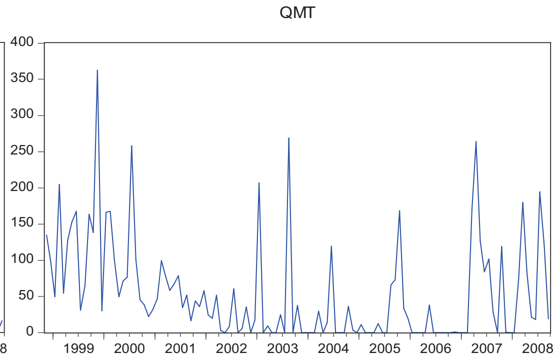

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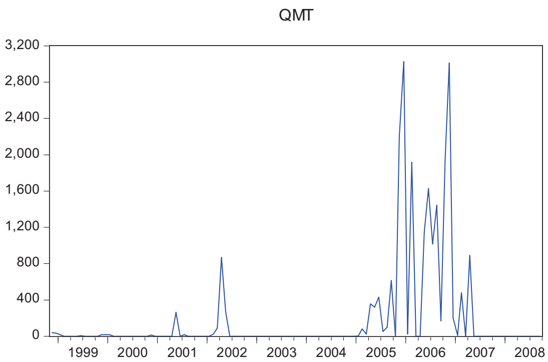

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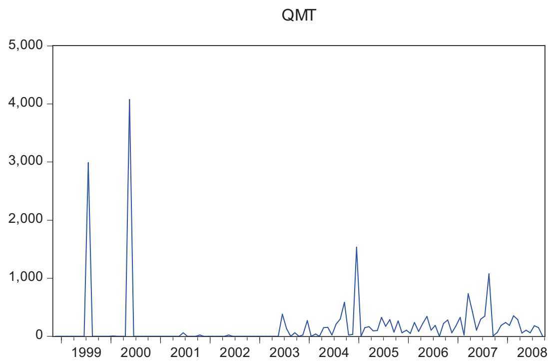

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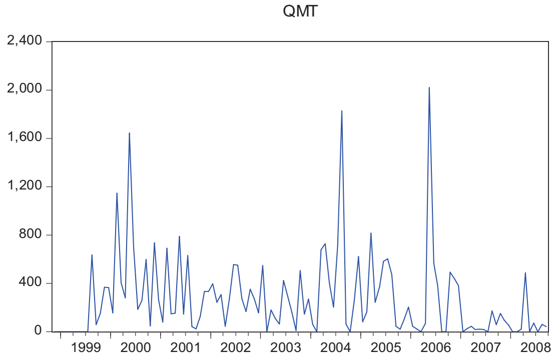

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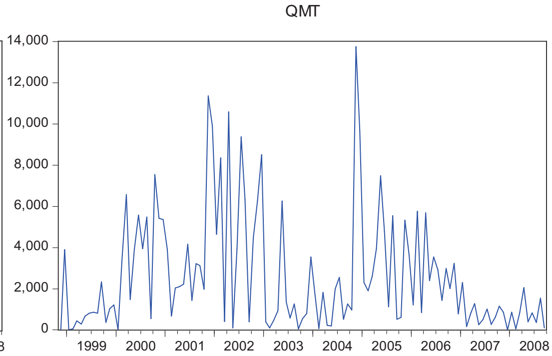

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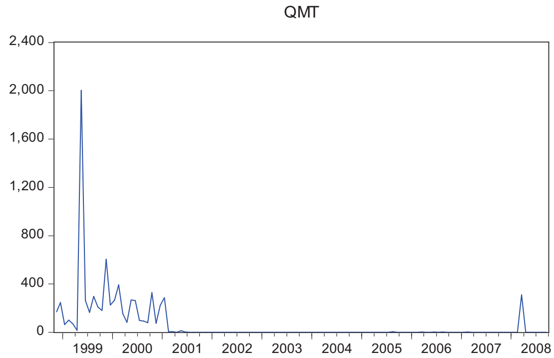

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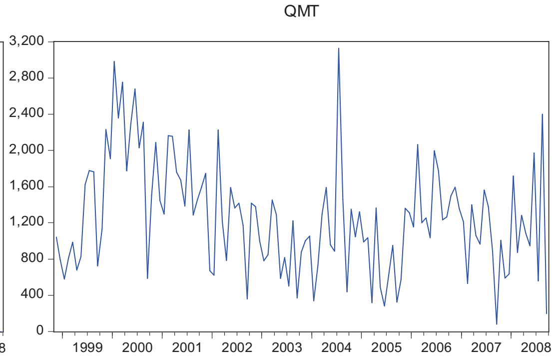

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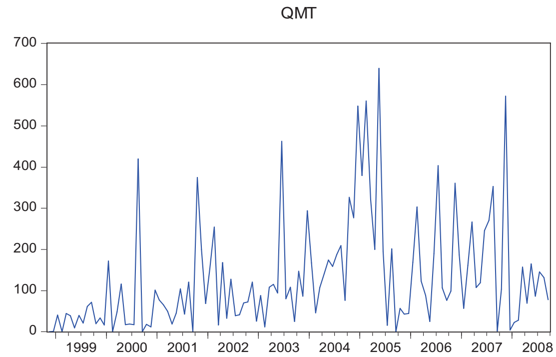

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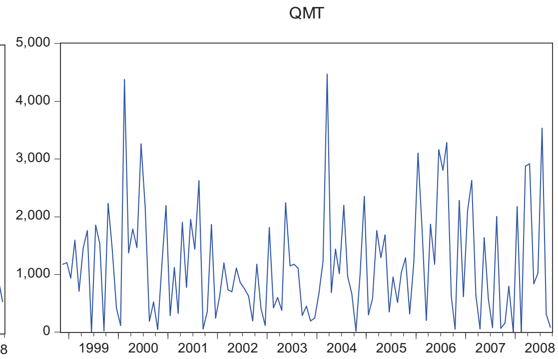

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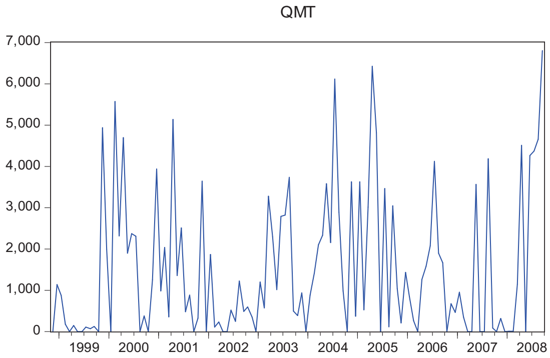

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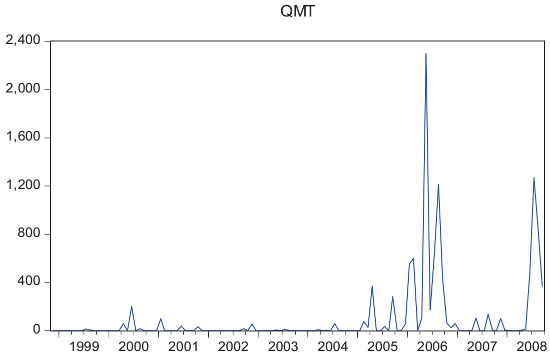

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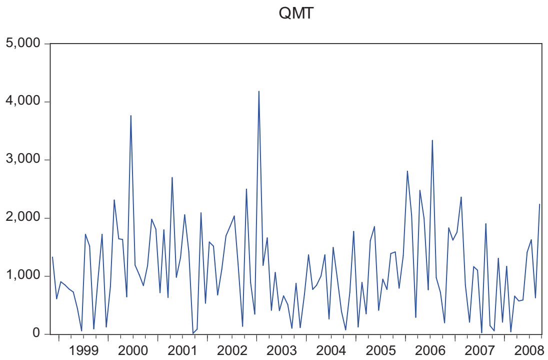

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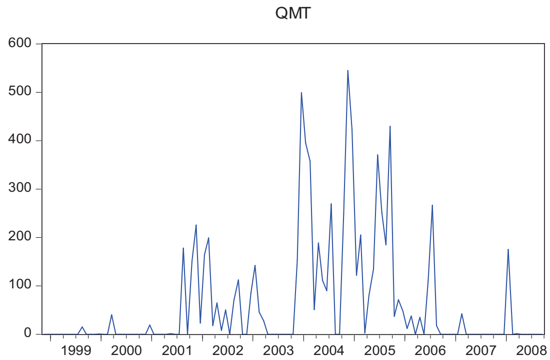

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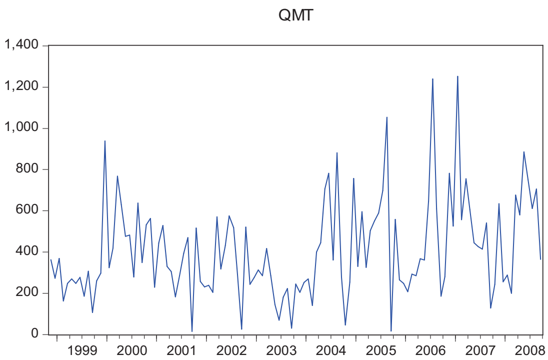

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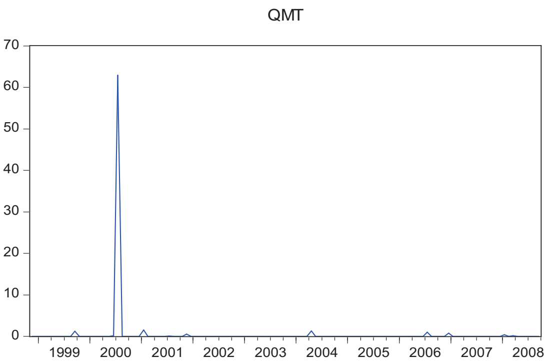

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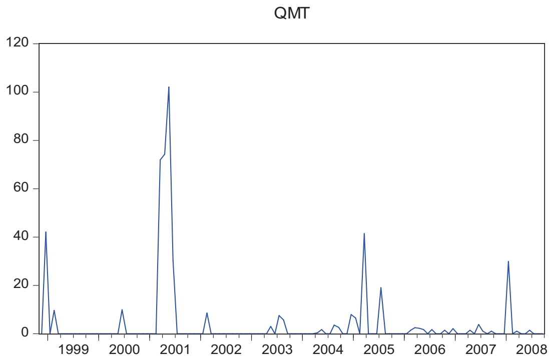

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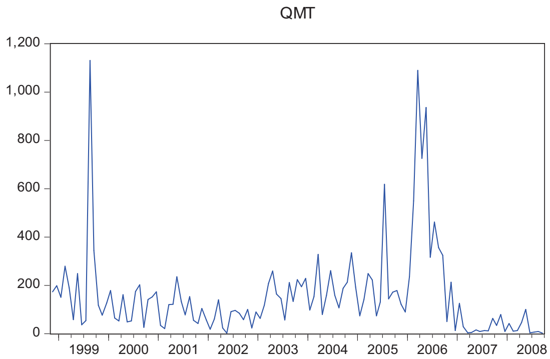

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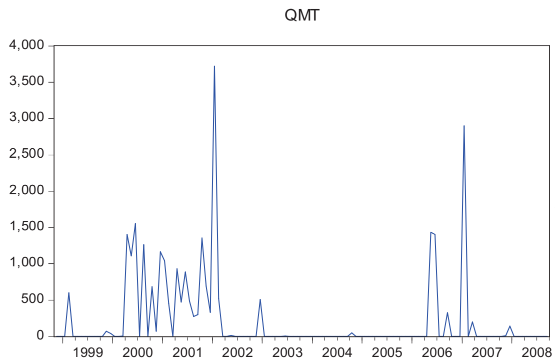

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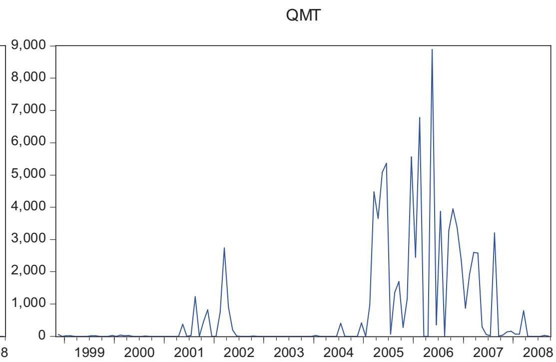

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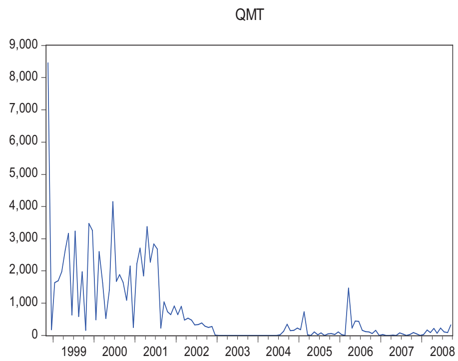

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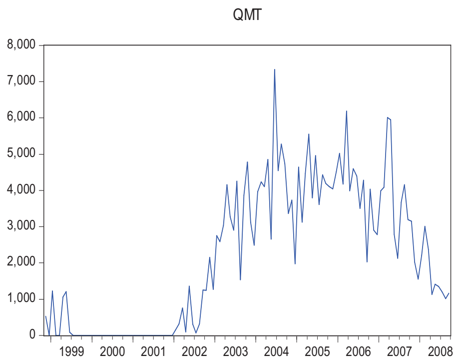

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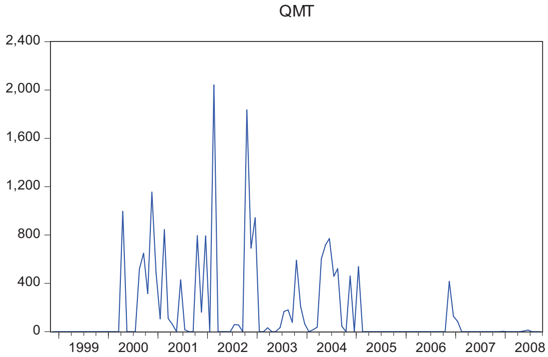
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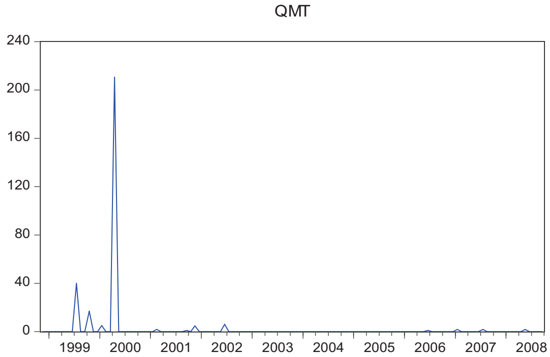
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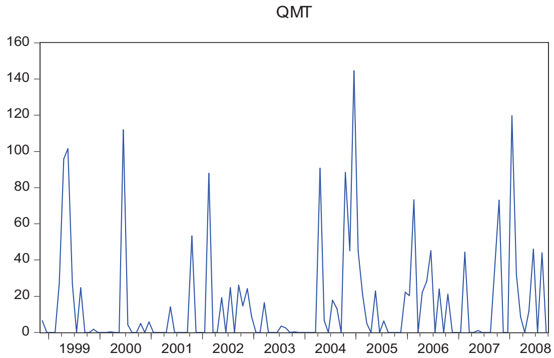
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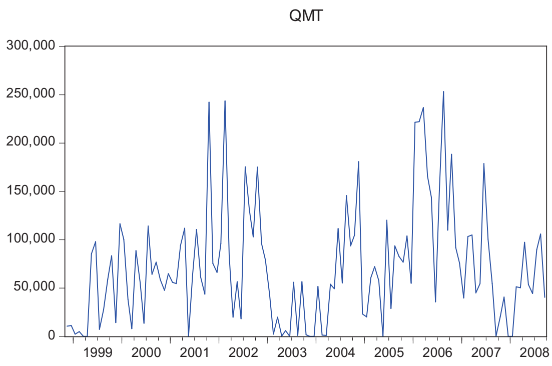
2.3.2 C.I.S.

2.3.2.1 Russia

1B



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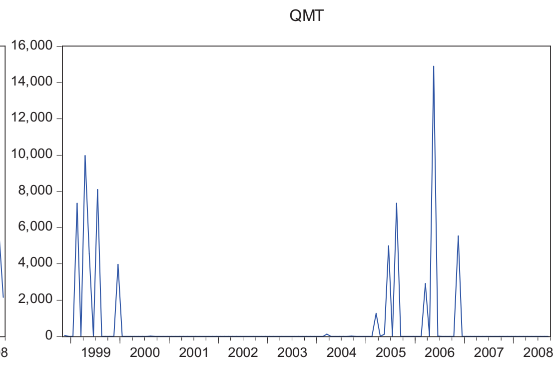

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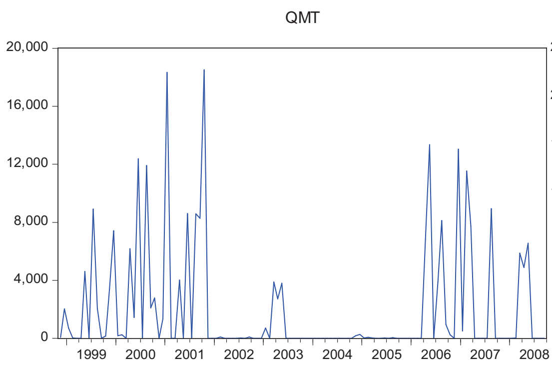

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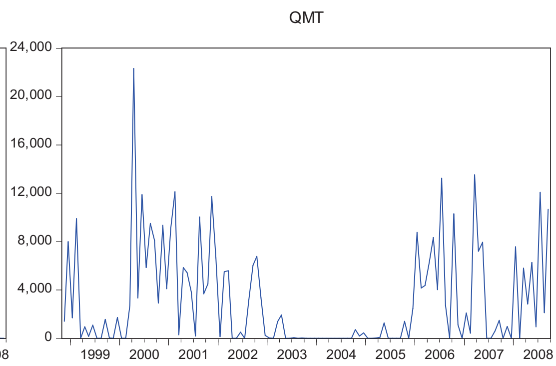

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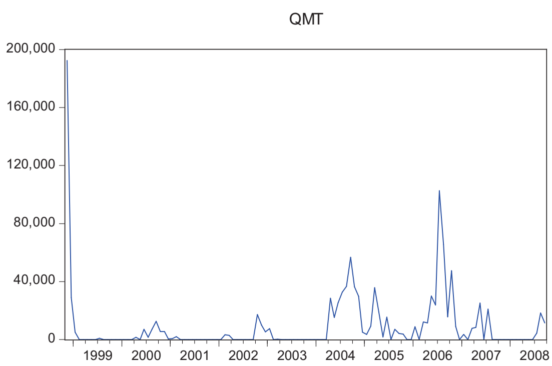

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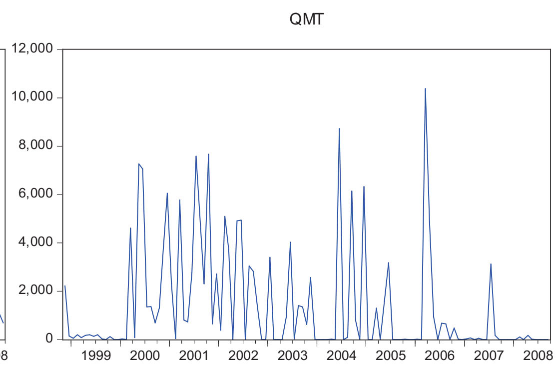

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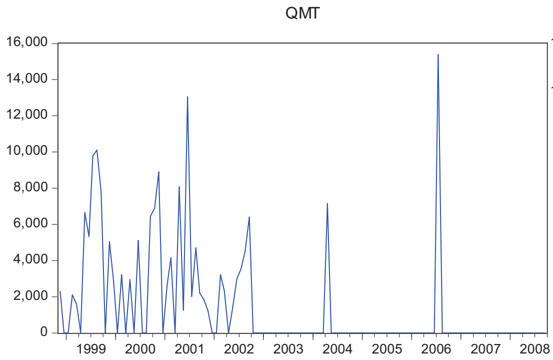

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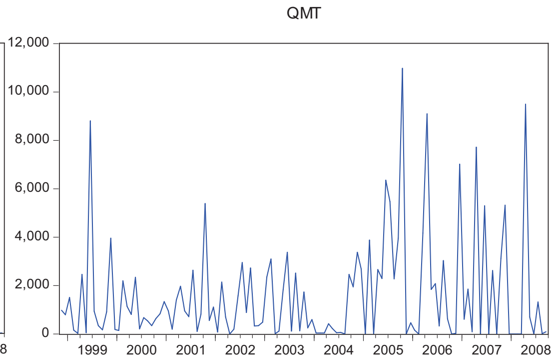

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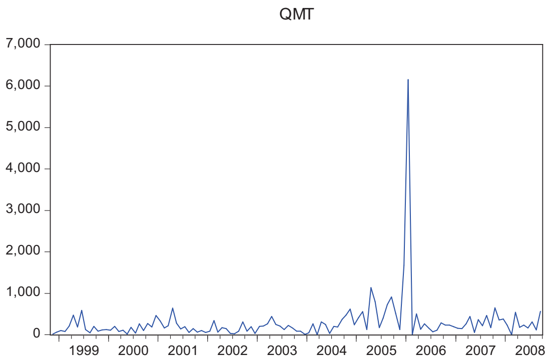

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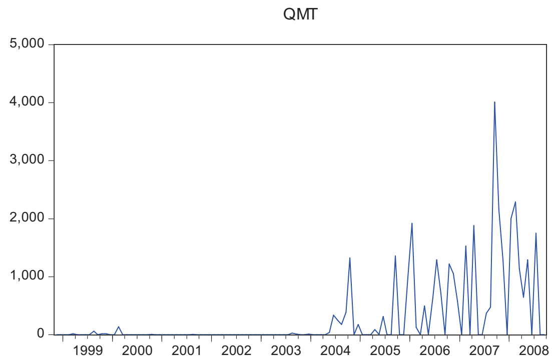

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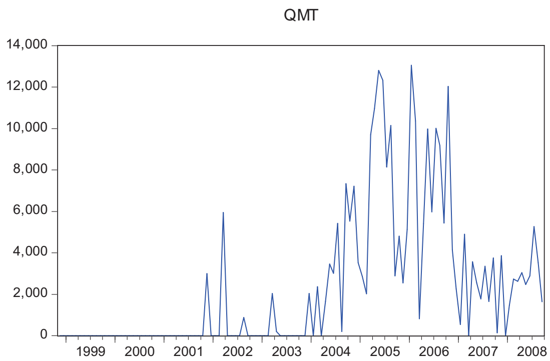

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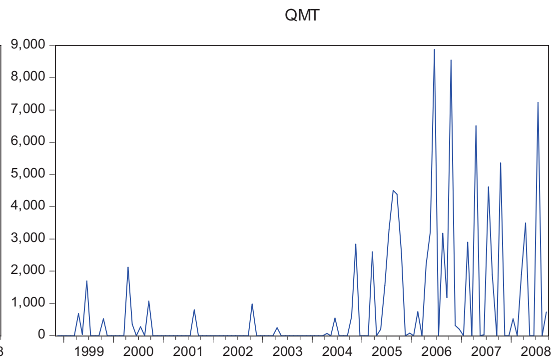

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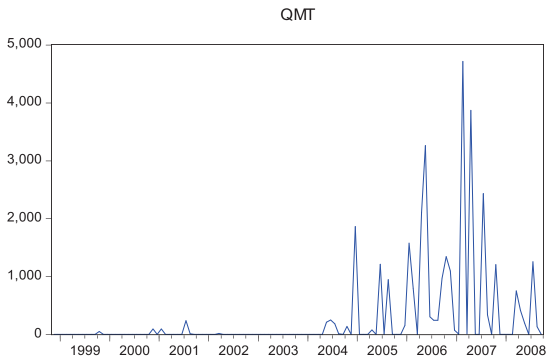

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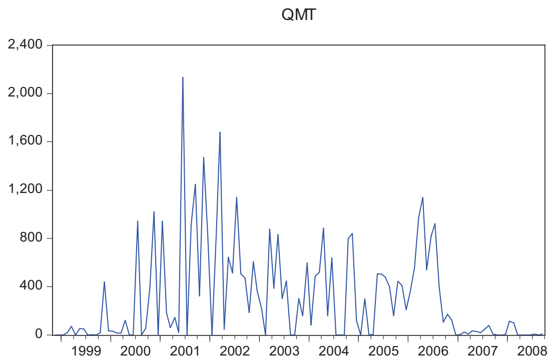

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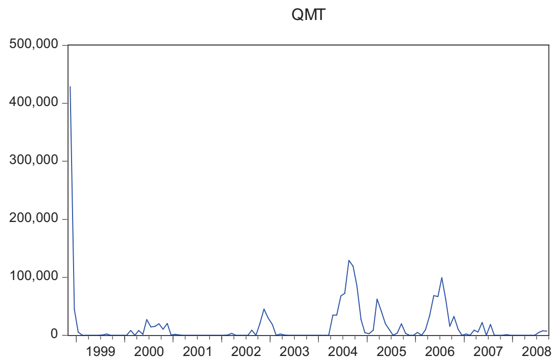

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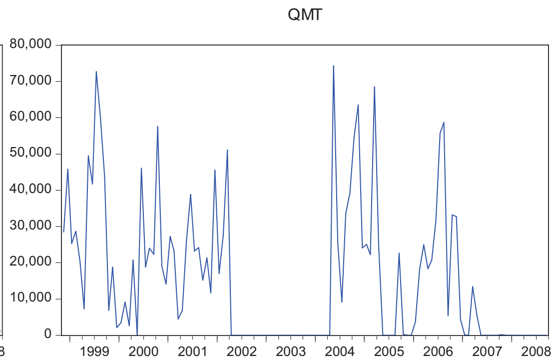

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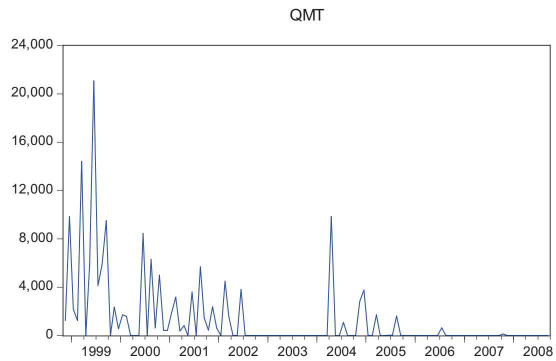

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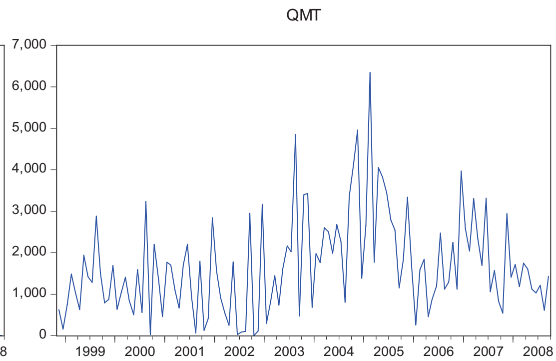

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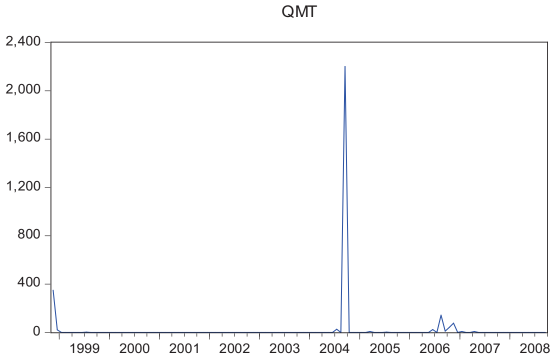

2.3.2.2 Ukraine

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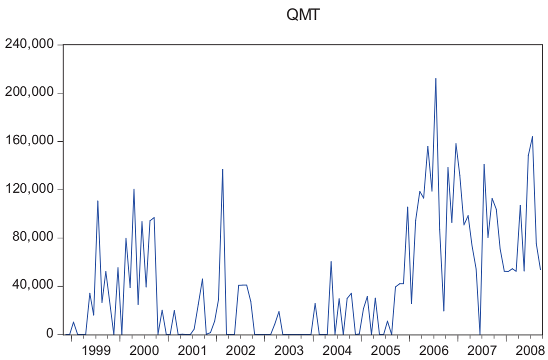

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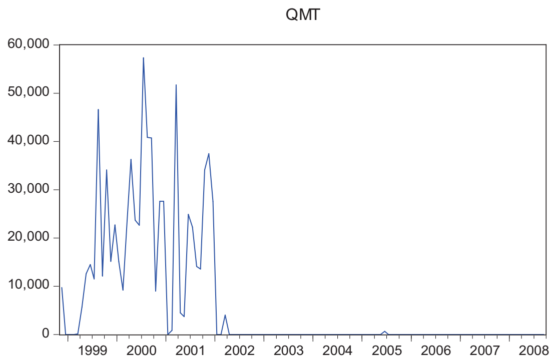

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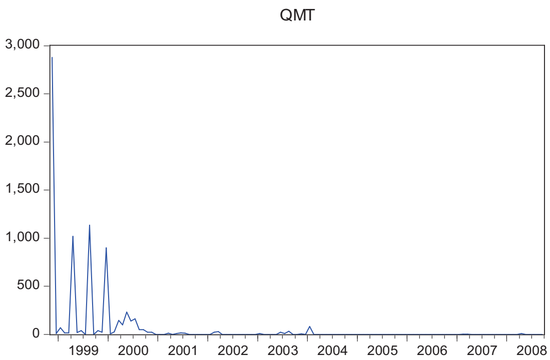

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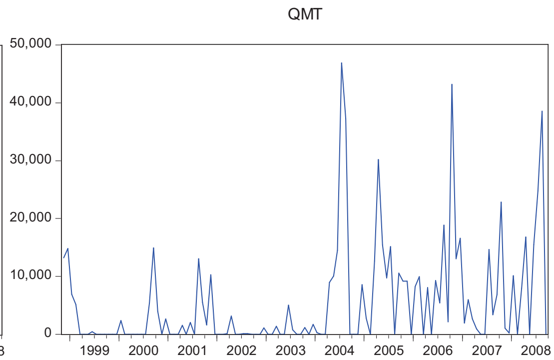

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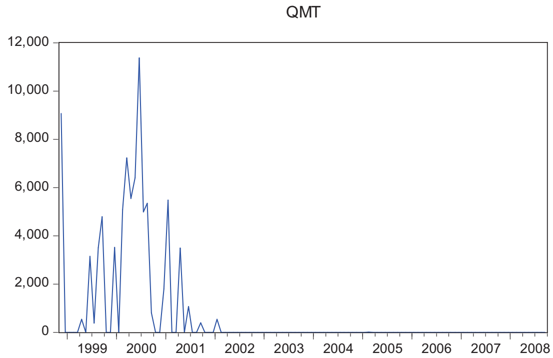

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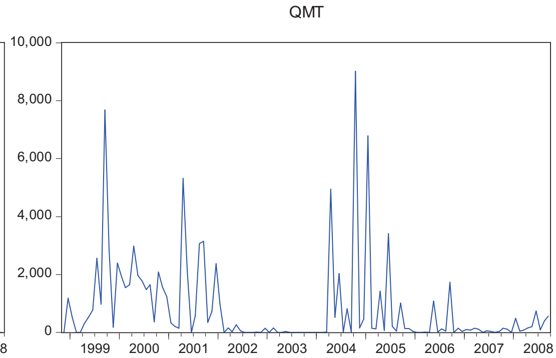

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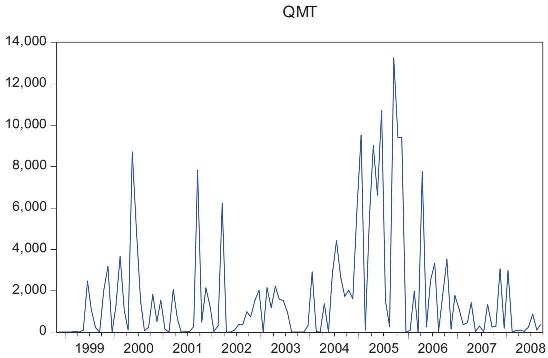

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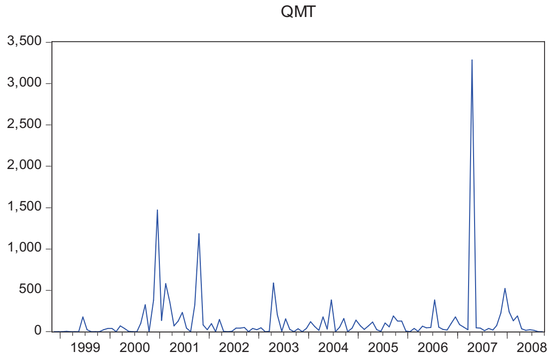

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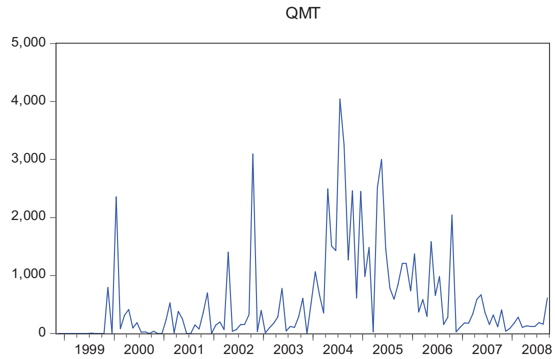

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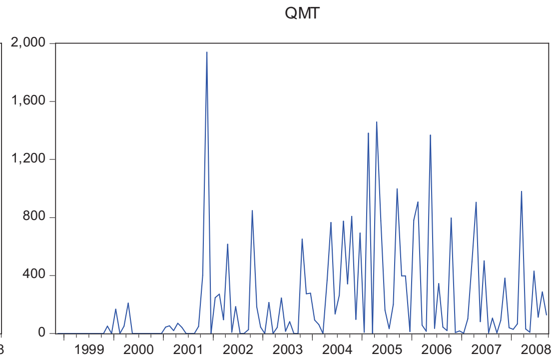

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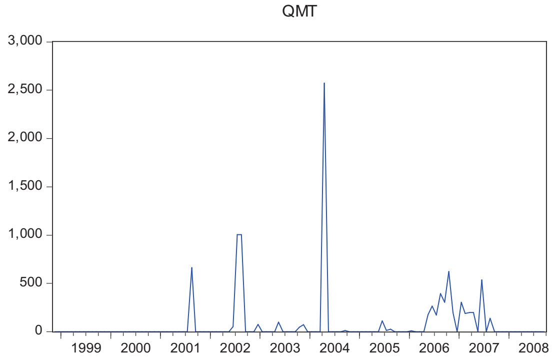

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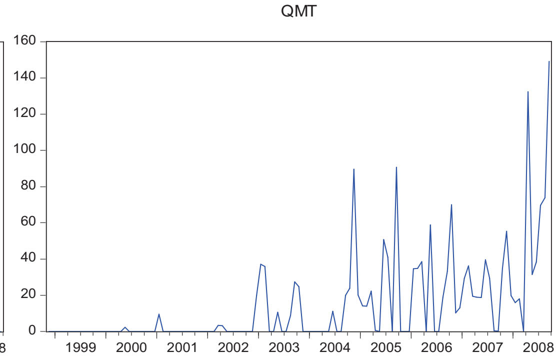

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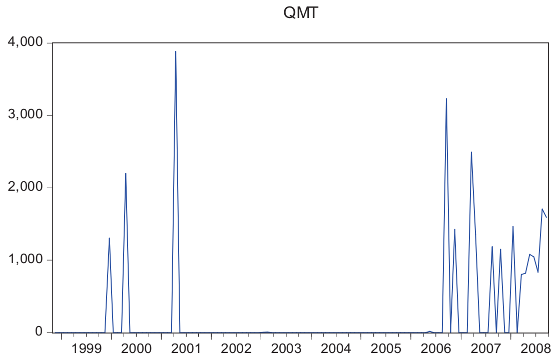

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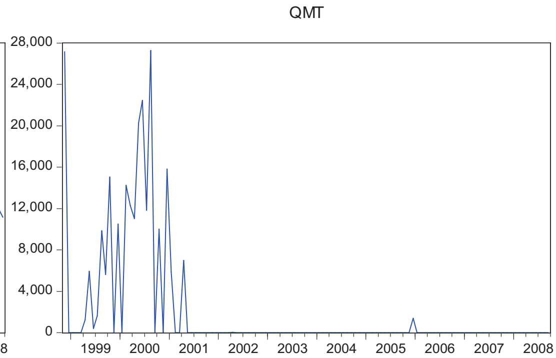

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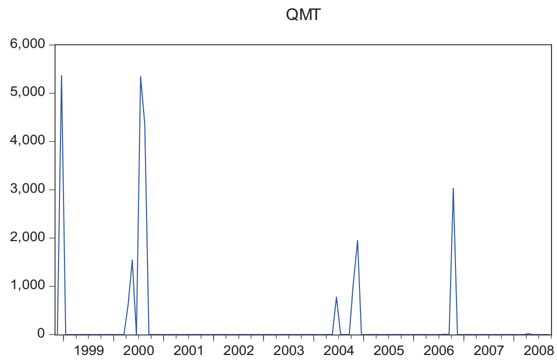

2.3.3 North America

2.3.3.1 Canada

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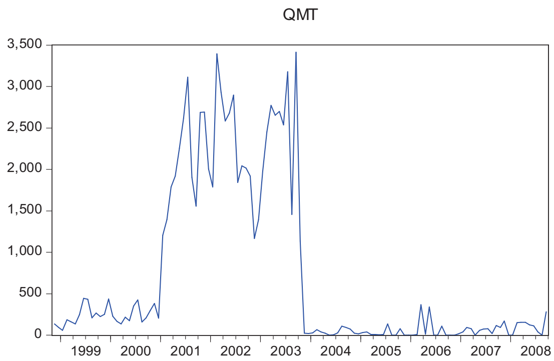

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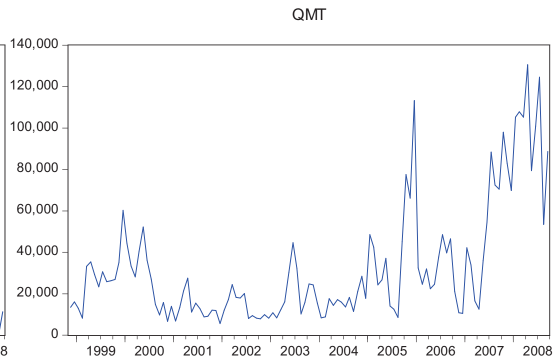

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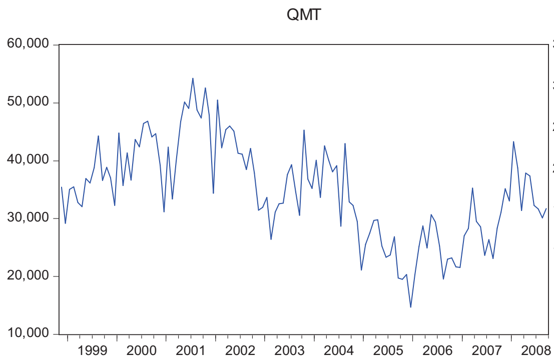

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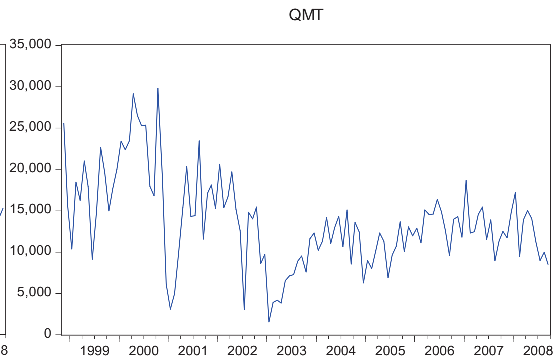

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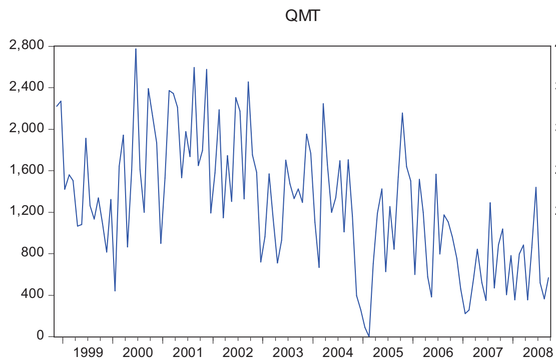

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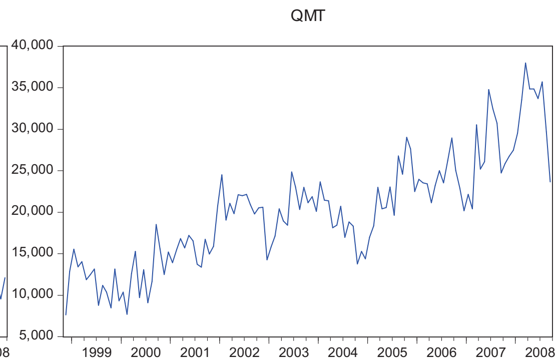

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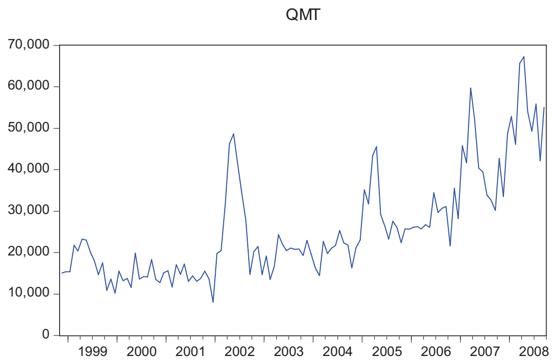
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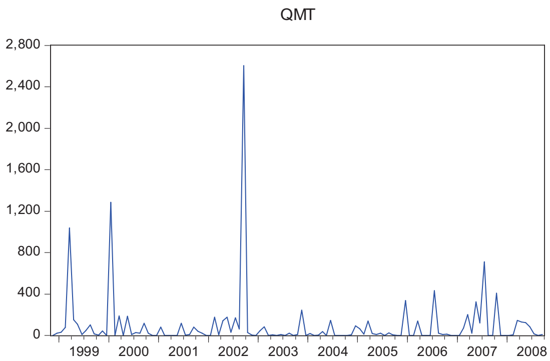
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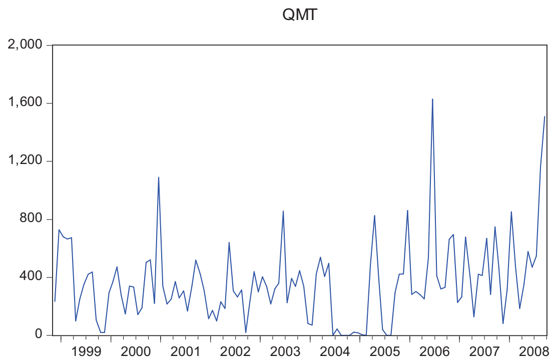
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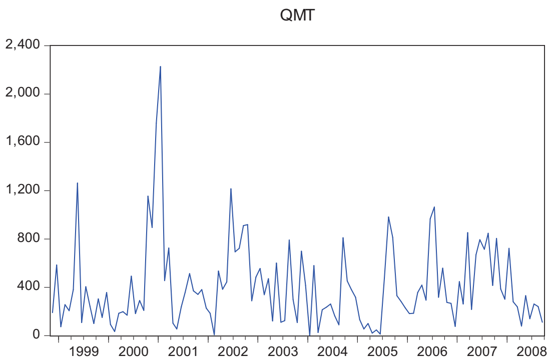
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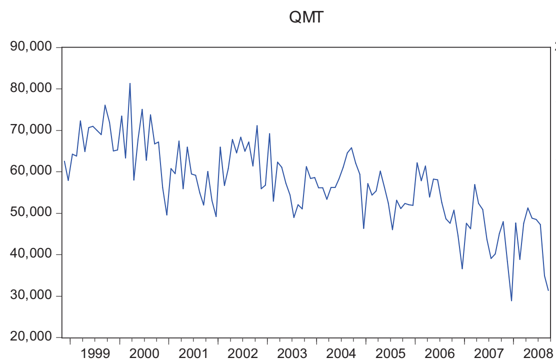
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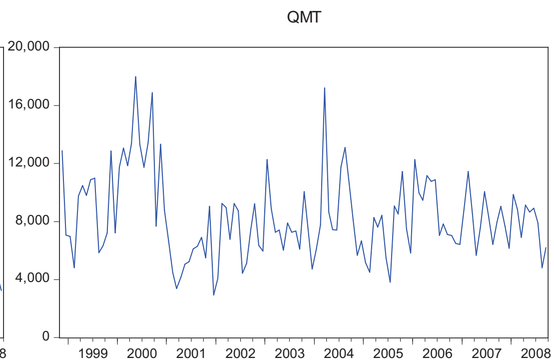
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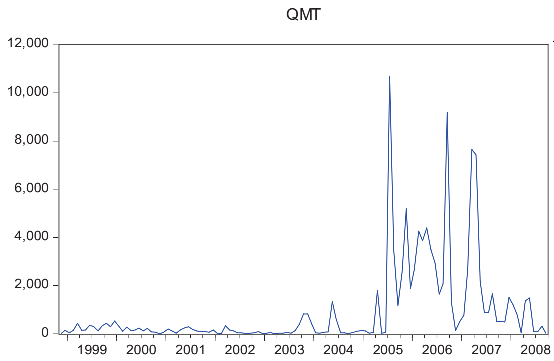

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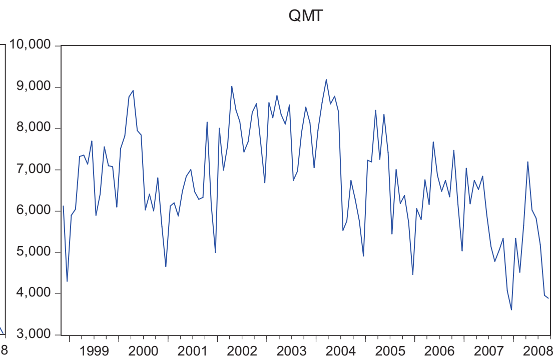

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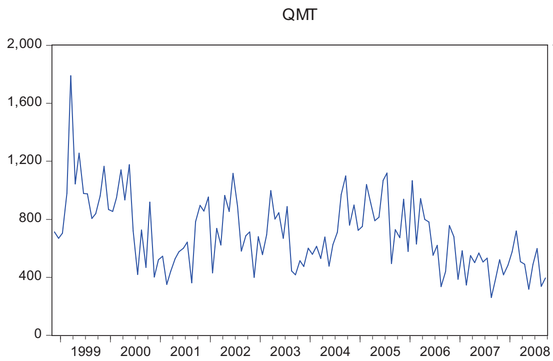

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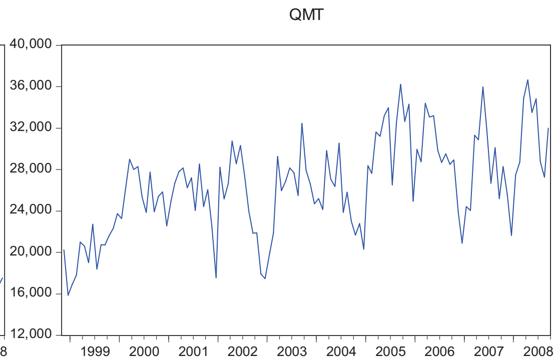

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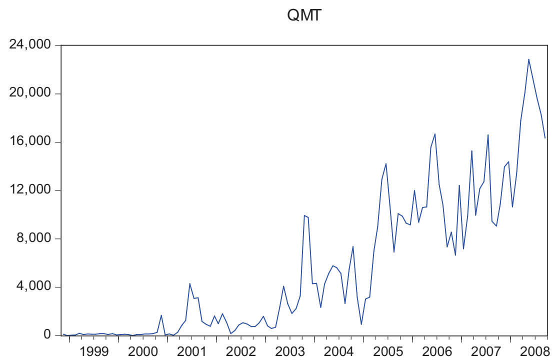

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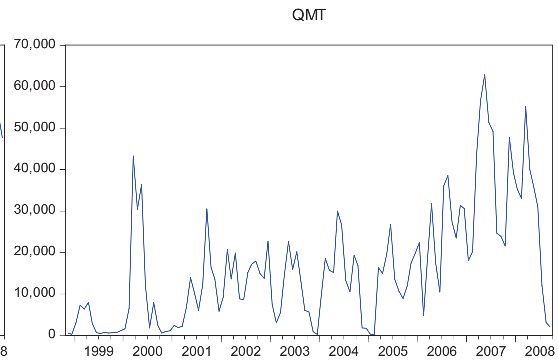

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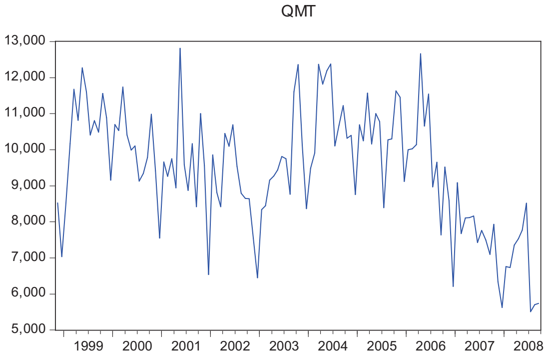

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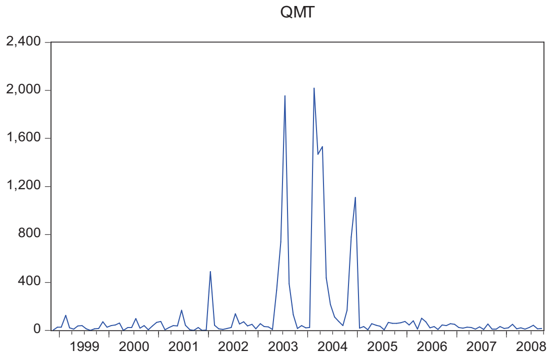

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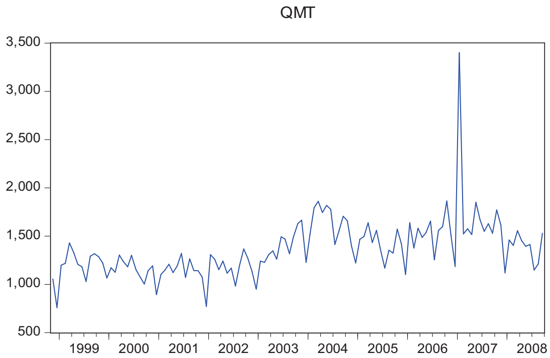

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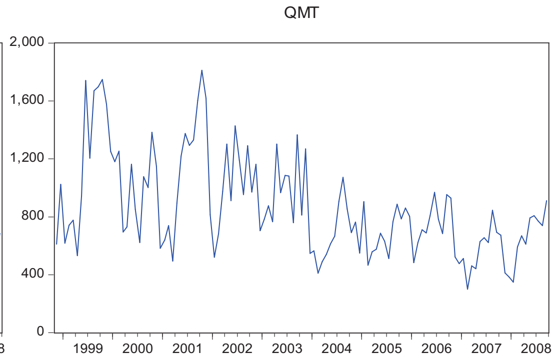

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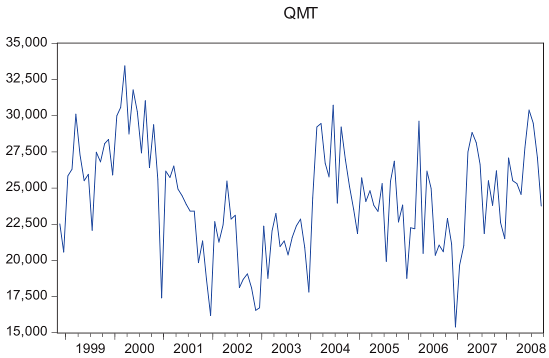

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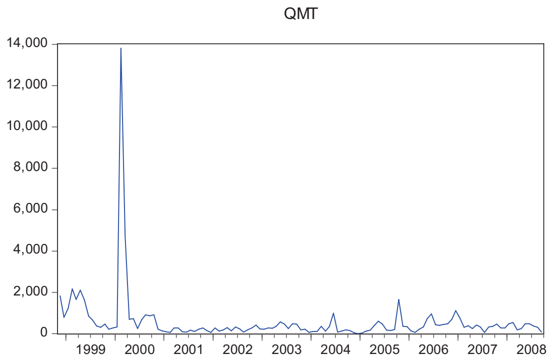

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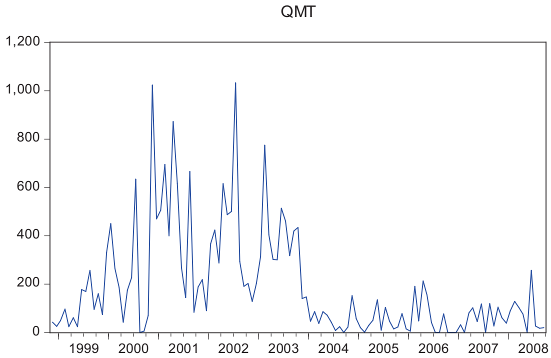

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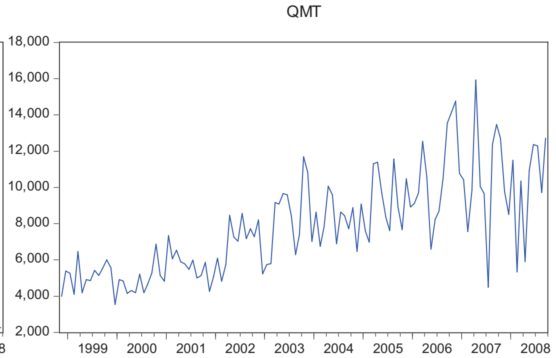

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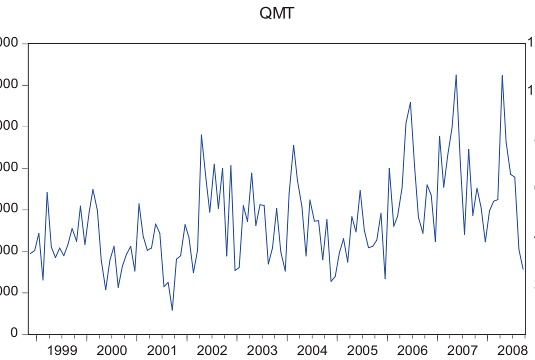

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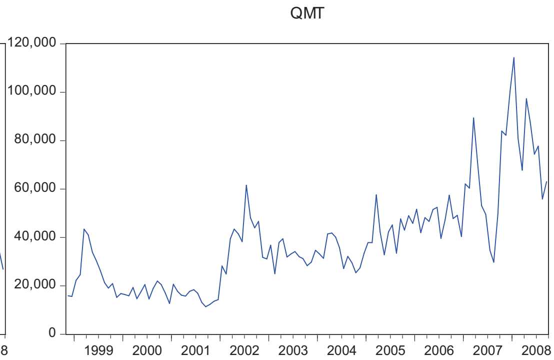

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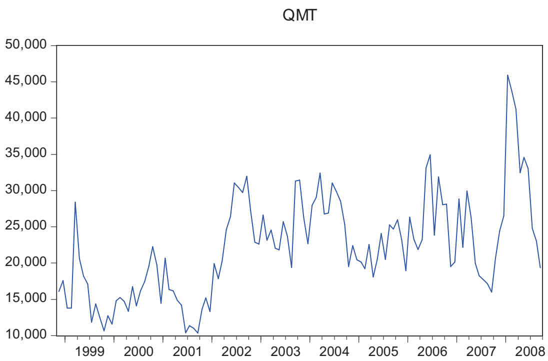

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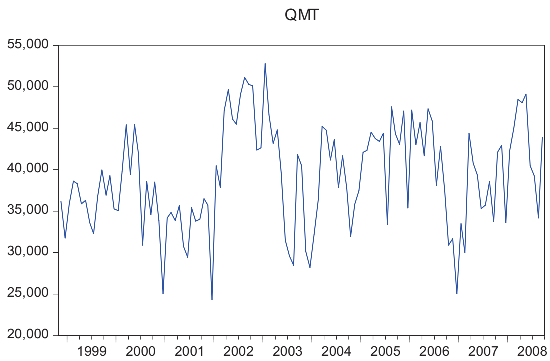

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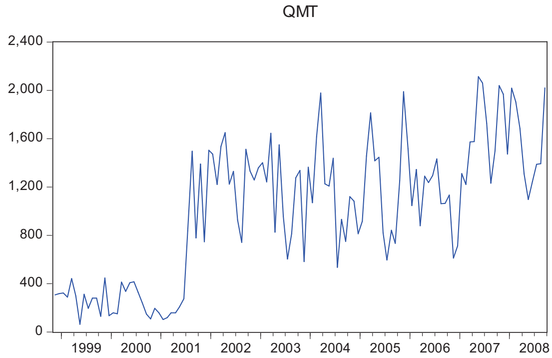

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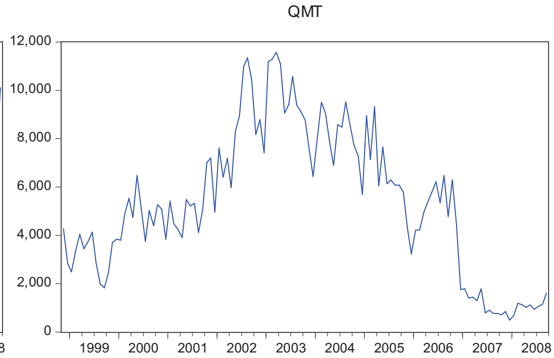

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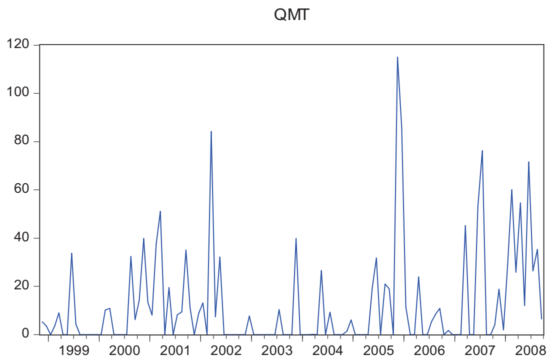

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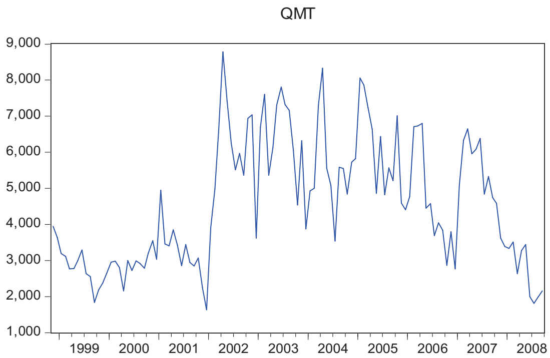

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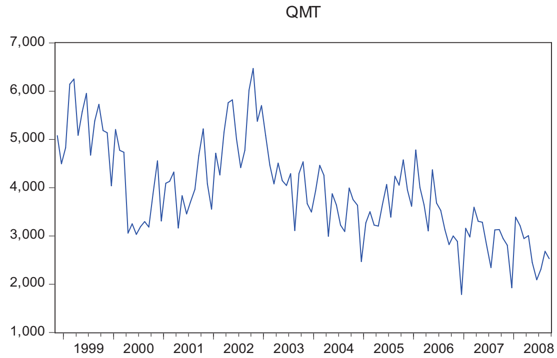
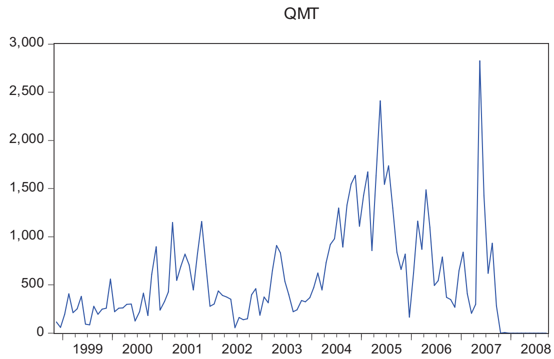
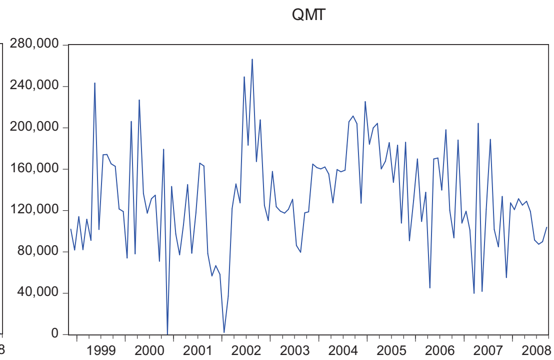


2.3.3.2 Mexico

1A



1B



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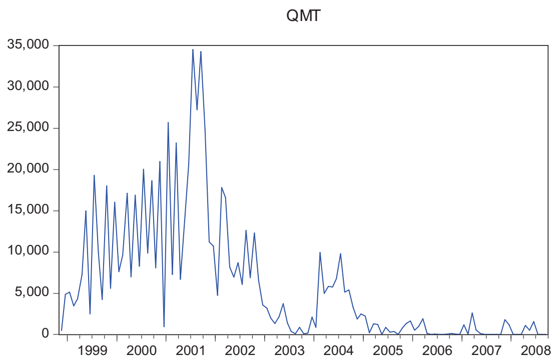

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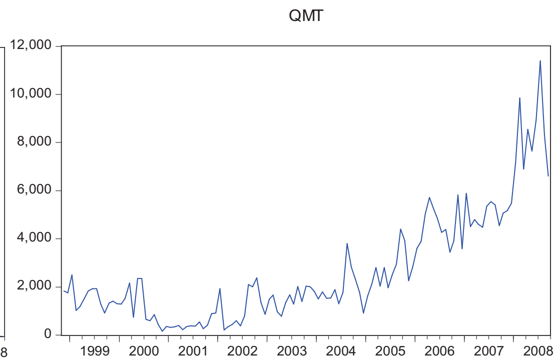

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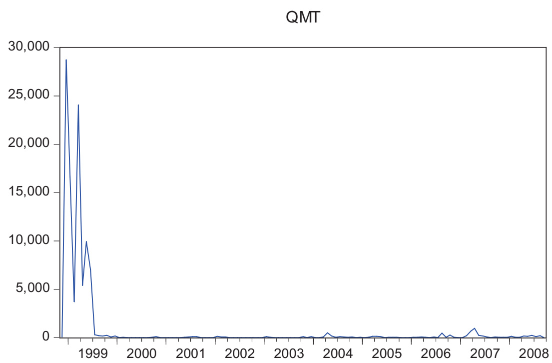
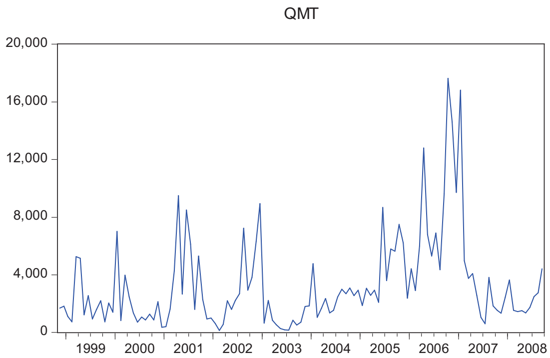


6B



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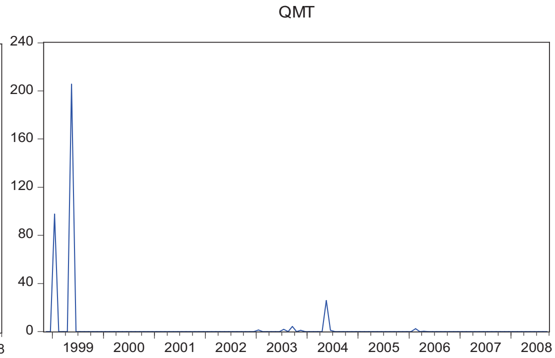

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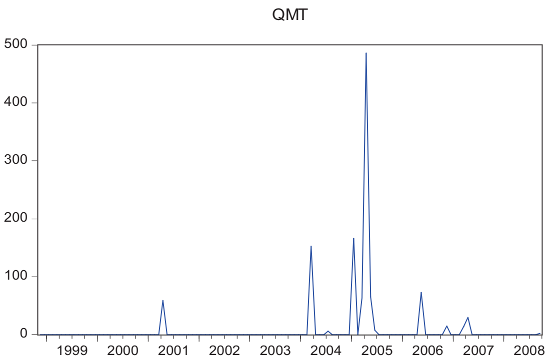

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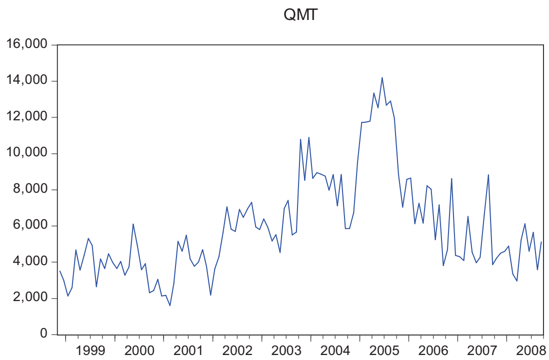
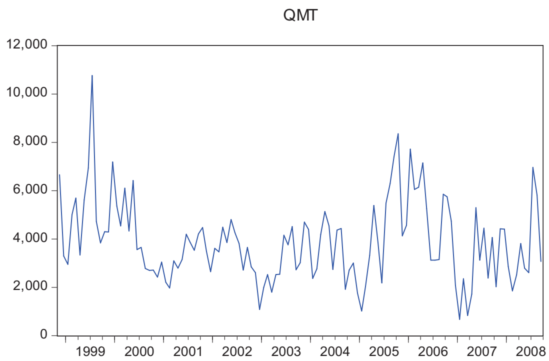


14A



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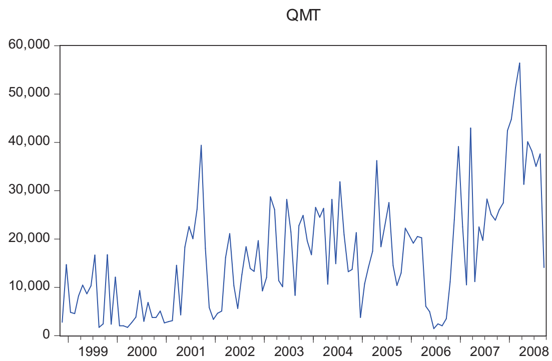

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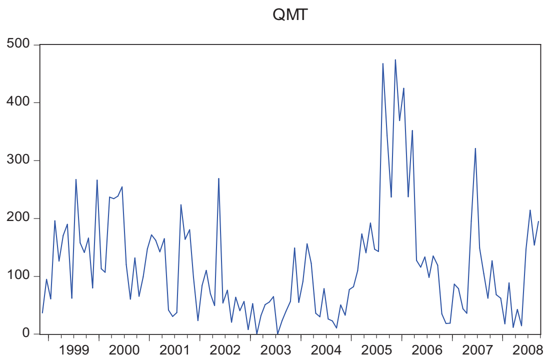

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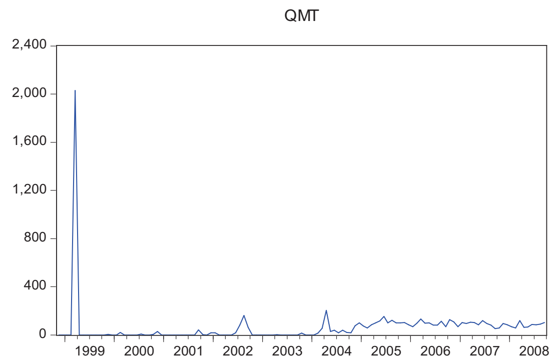

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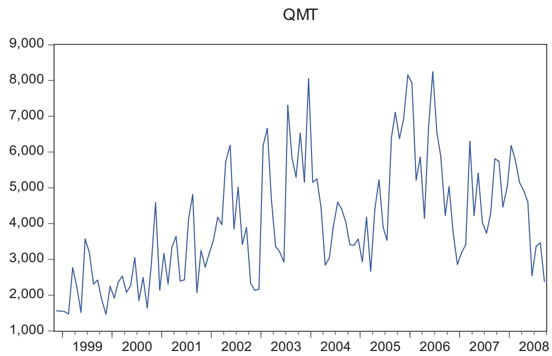

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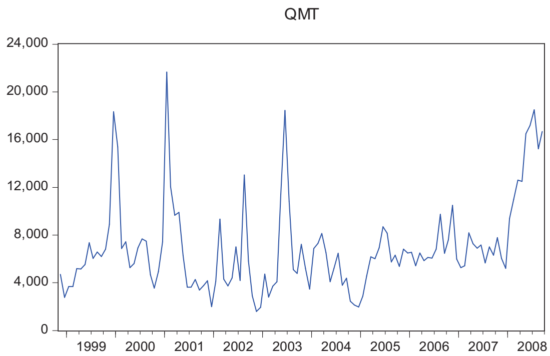

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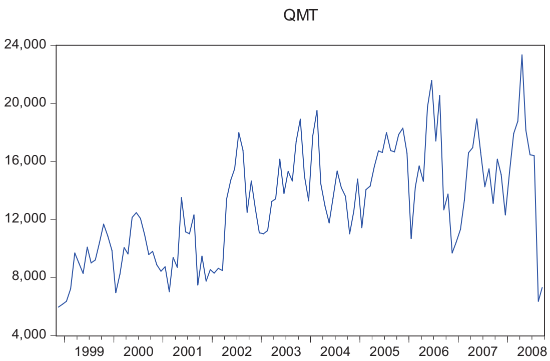
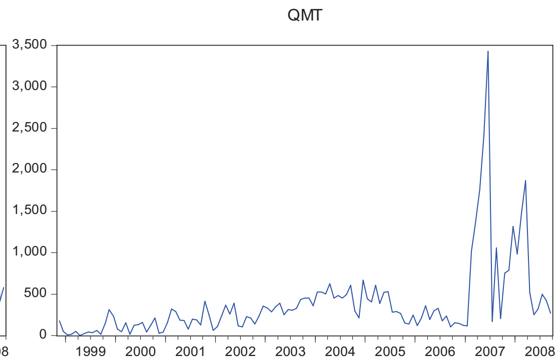


21B



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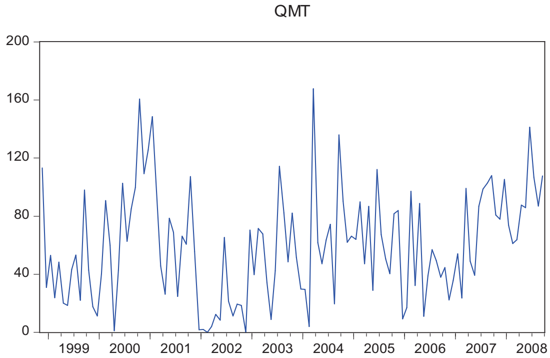

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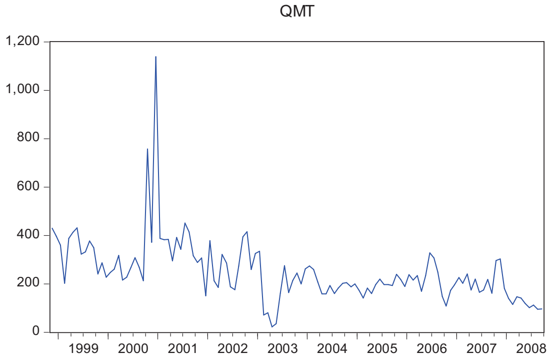

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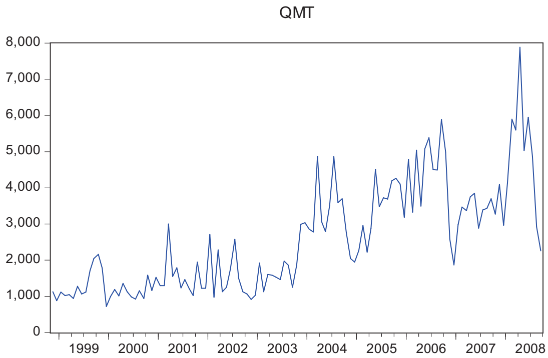

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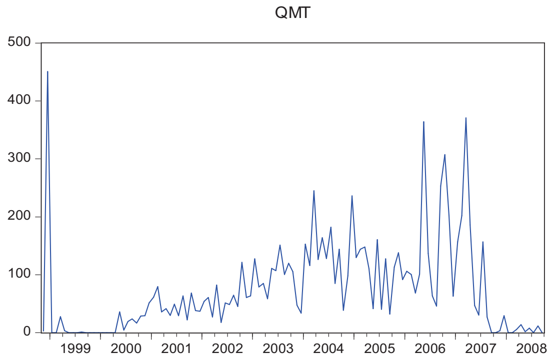

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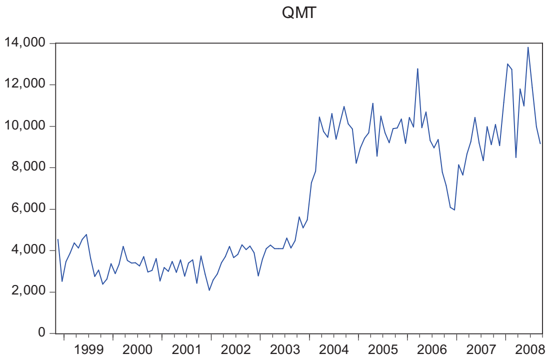

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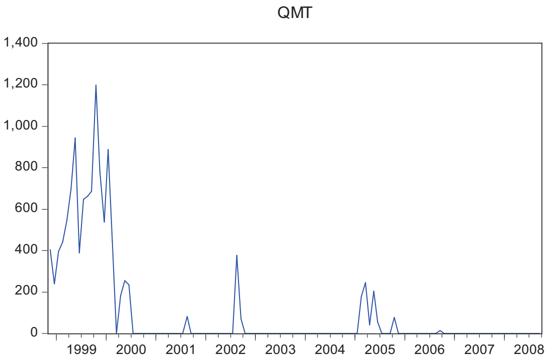

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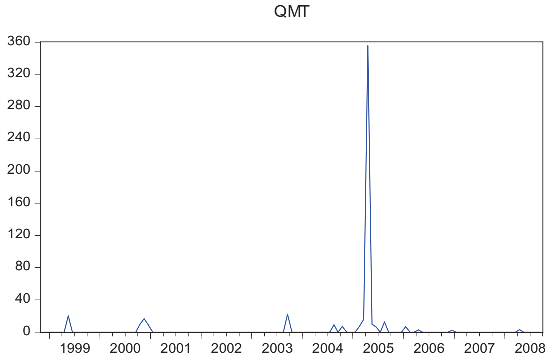

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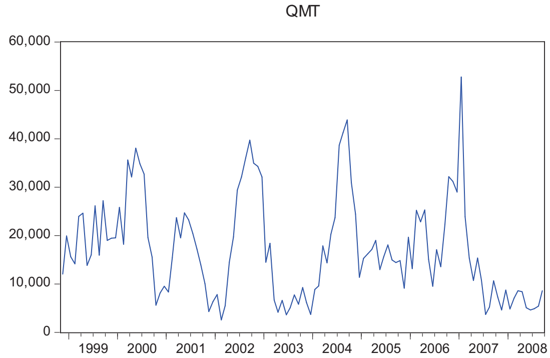

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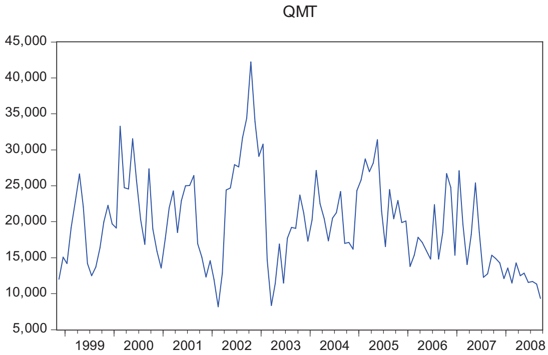

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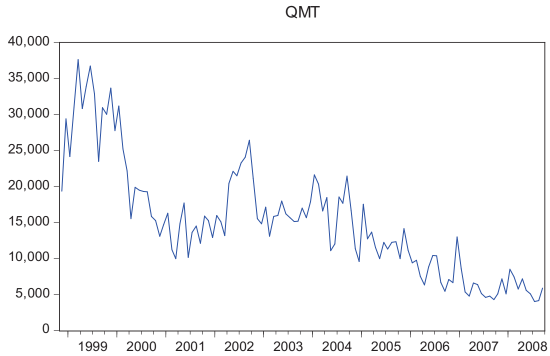
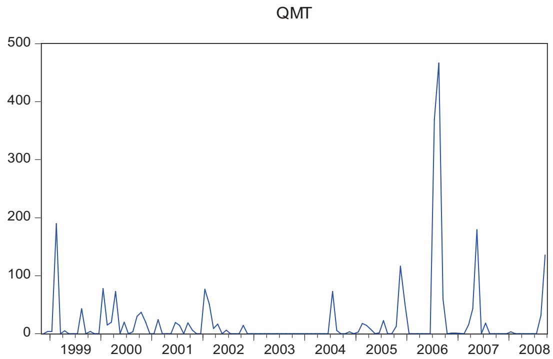


33B



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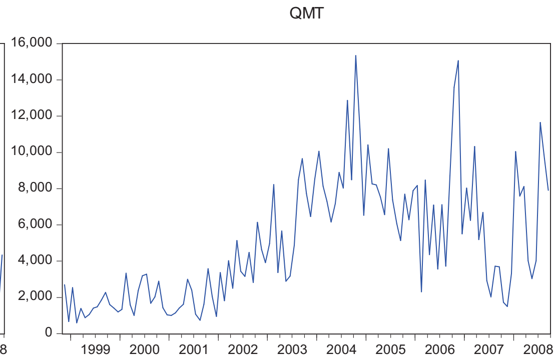

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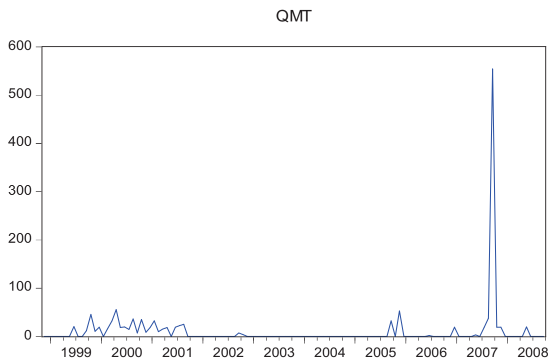
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500
400
300
200
100
0
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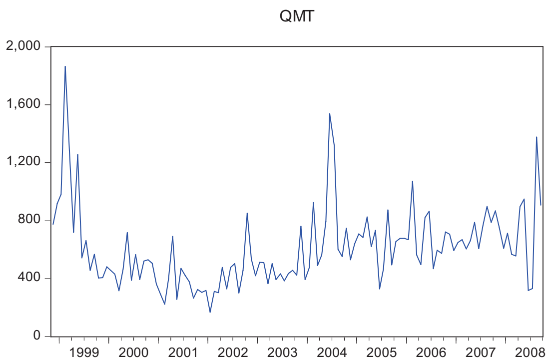
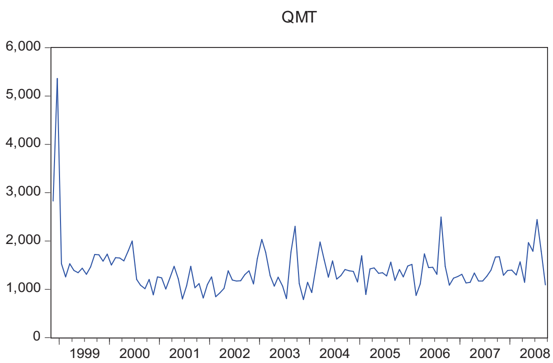
36


QMT
2,000
1,600
1,200
800
400
0
1999 2000 2001 2002 2003 2004 2005 2006 2007 2008

37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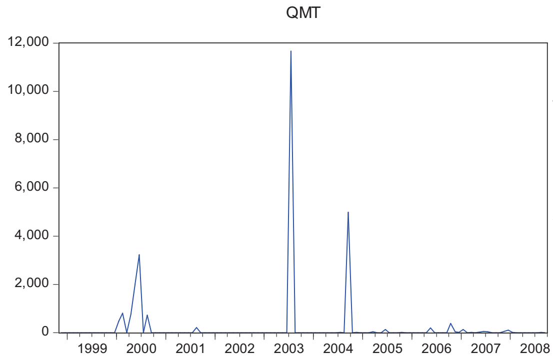
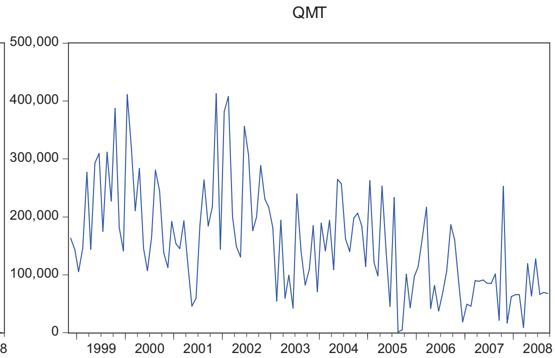
2.3.4 South America (Brazil)

1A



1B



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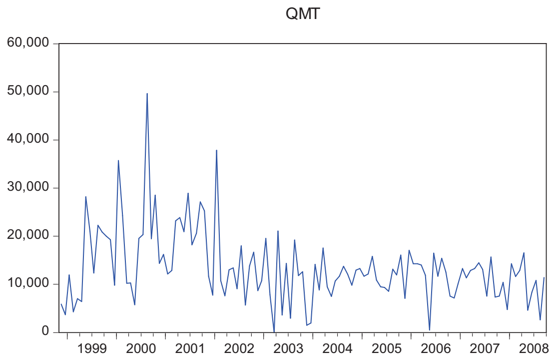

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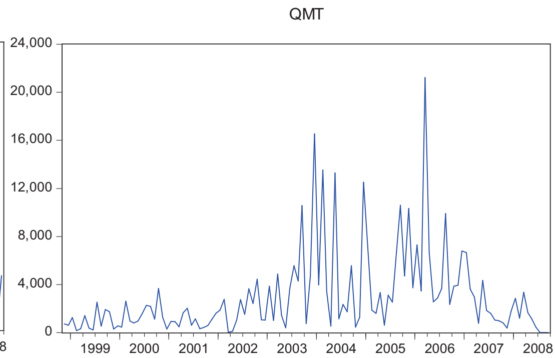

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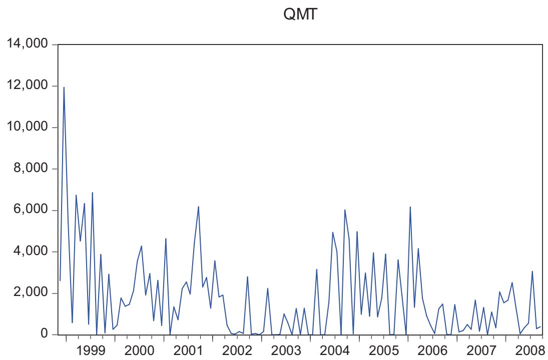

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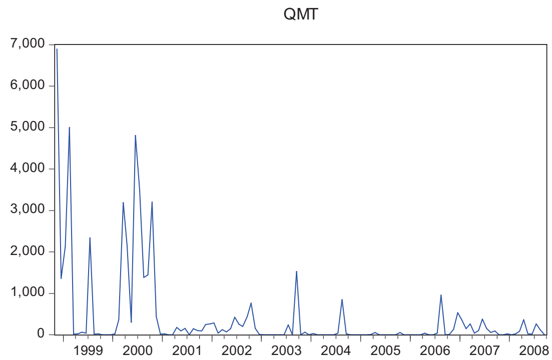

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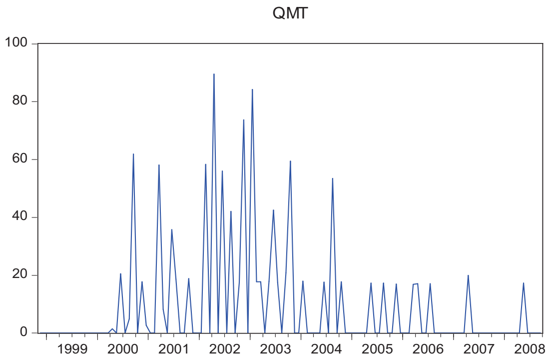

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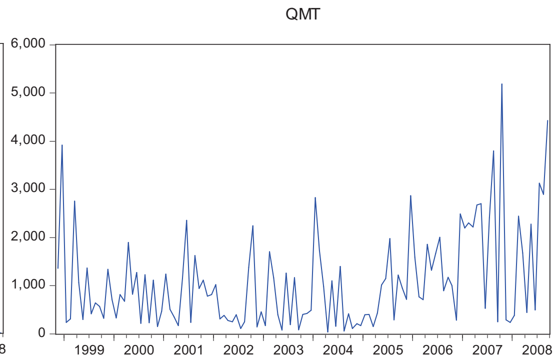
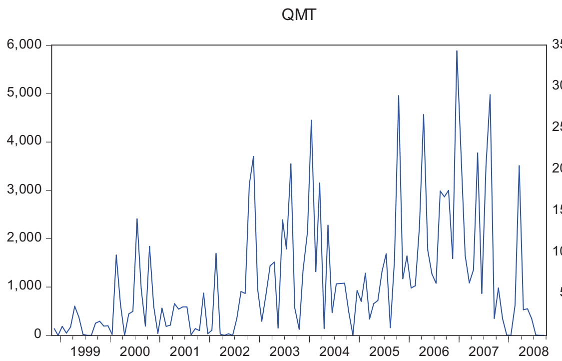


14A



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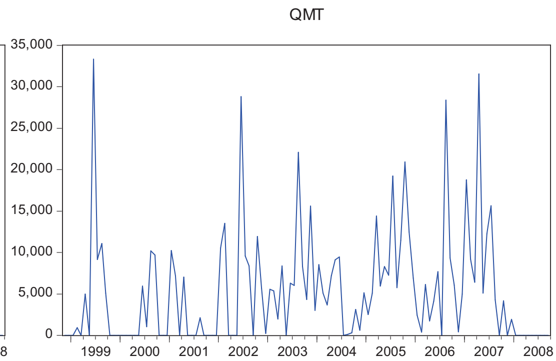

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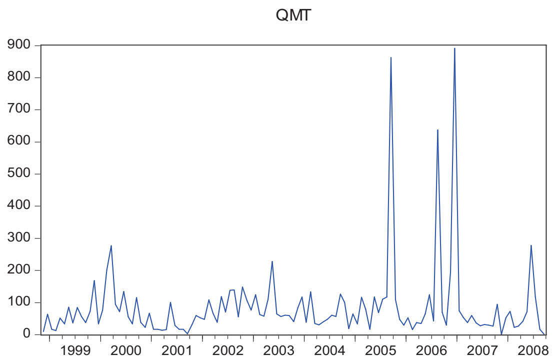

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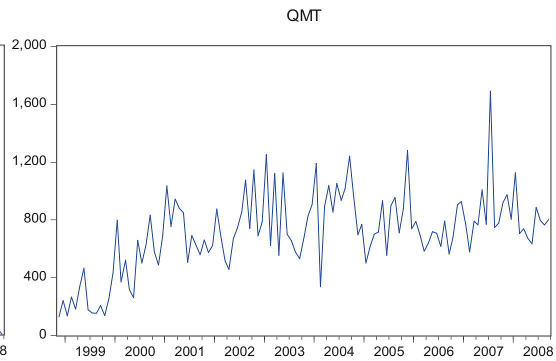

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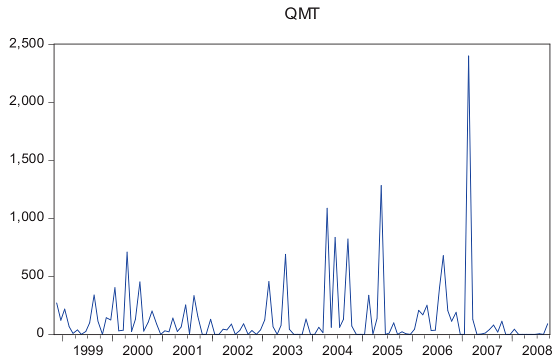

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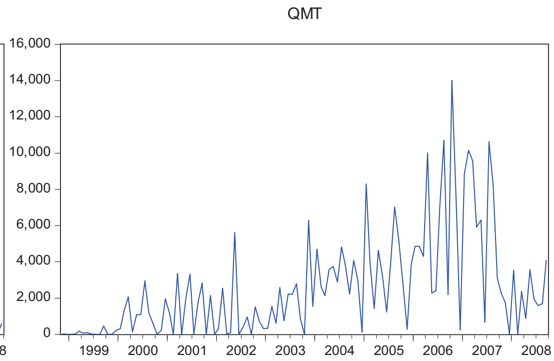

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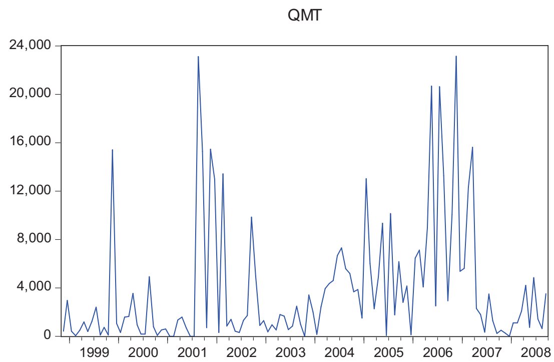
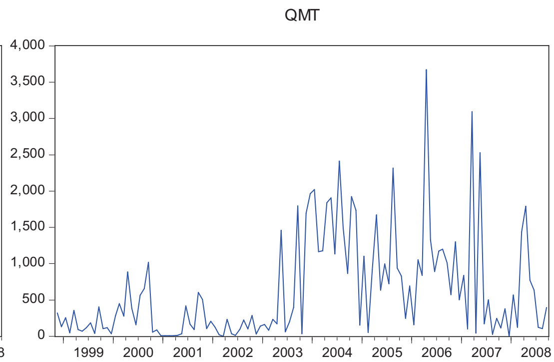
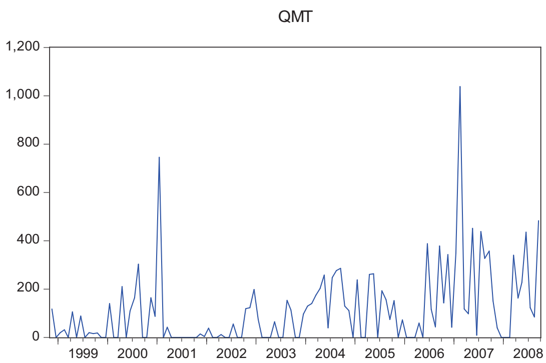


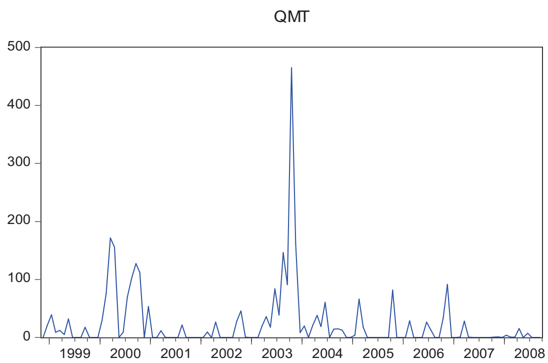
21A



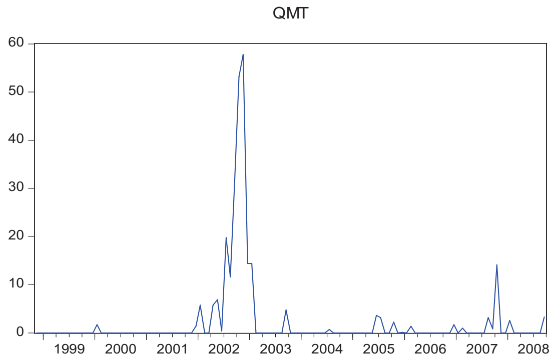
21B



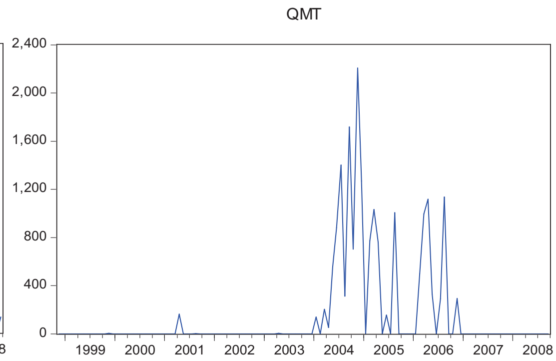
21CD



21E



22A



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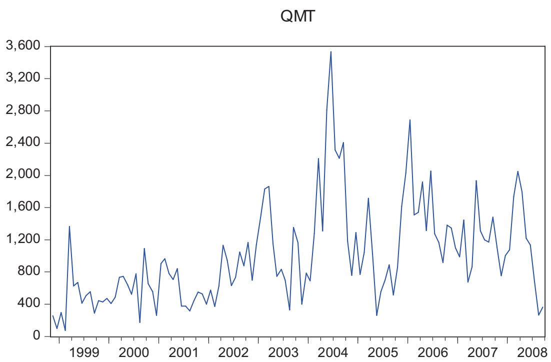

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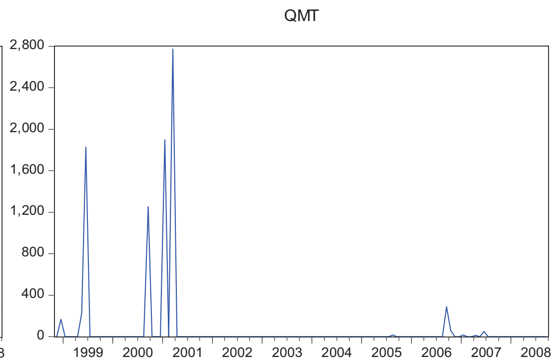

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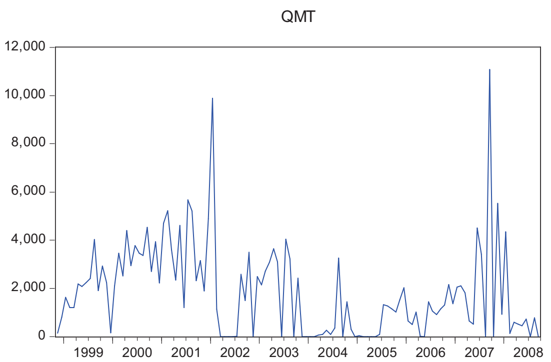
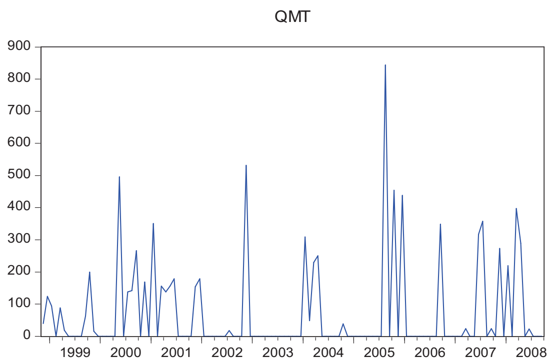


29A



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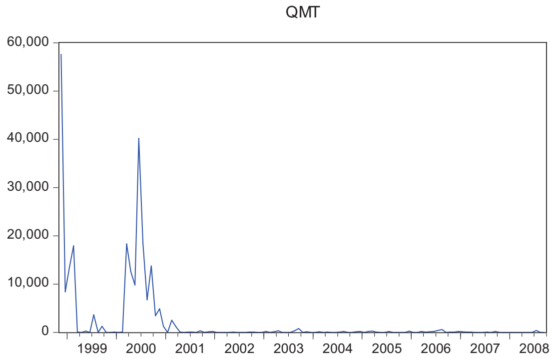

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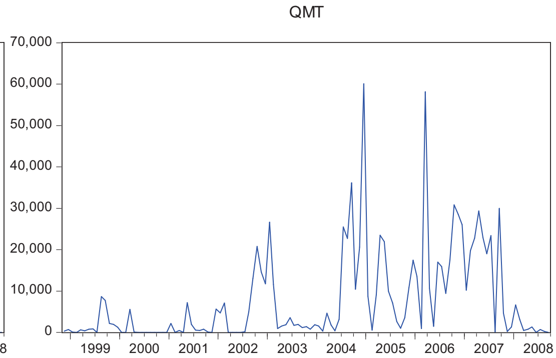
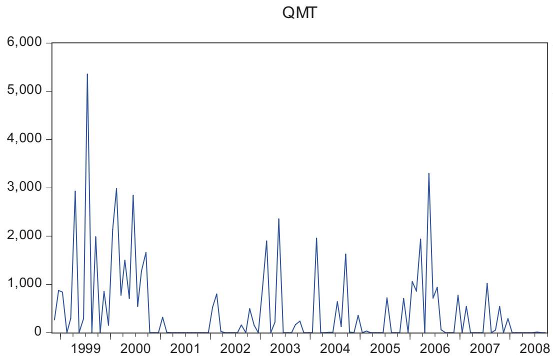


33B



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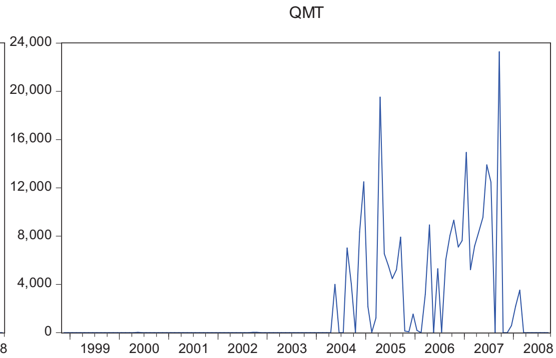

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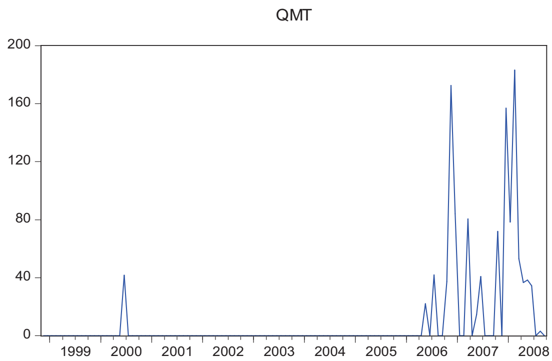

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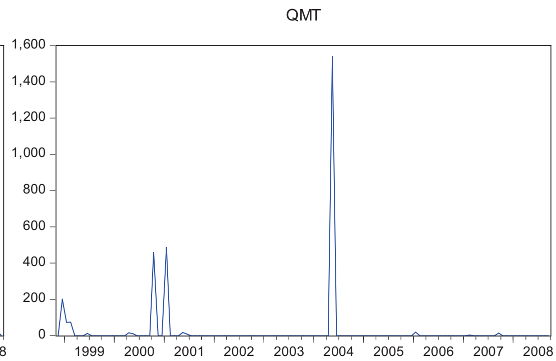
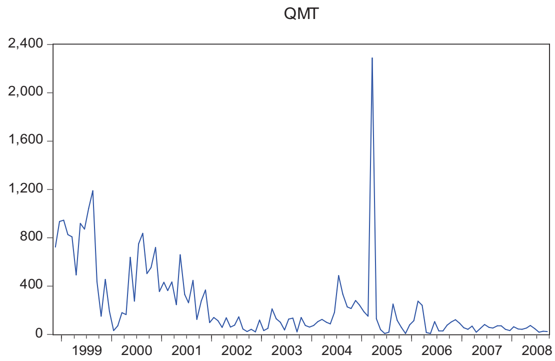
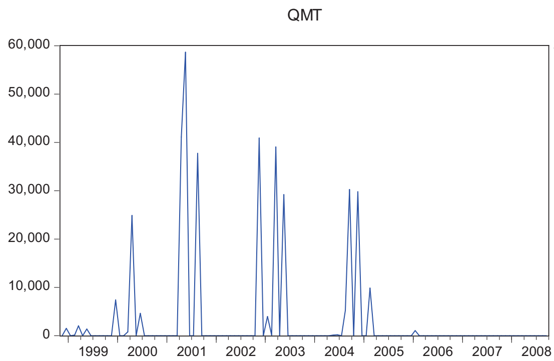


37



2.3.5 Africa (South Africa)

1B



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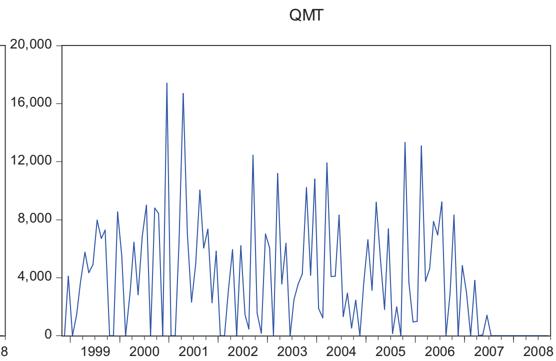

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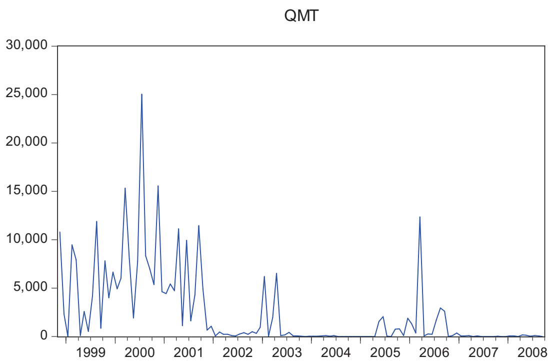
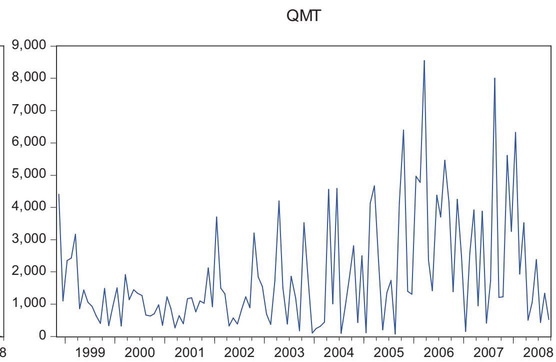
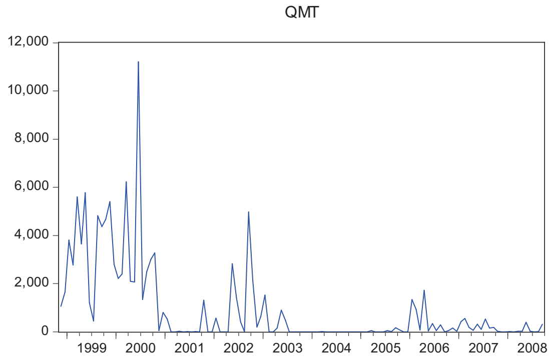


6A



6B



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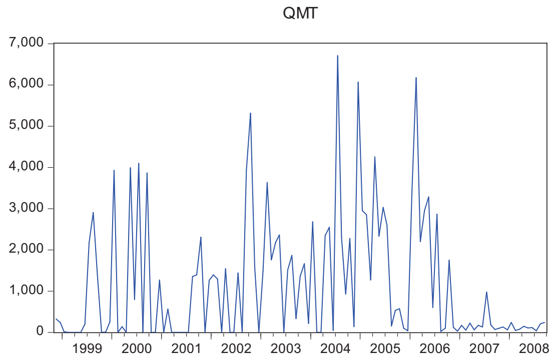

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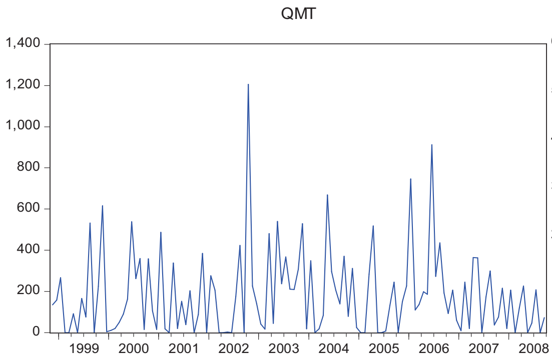

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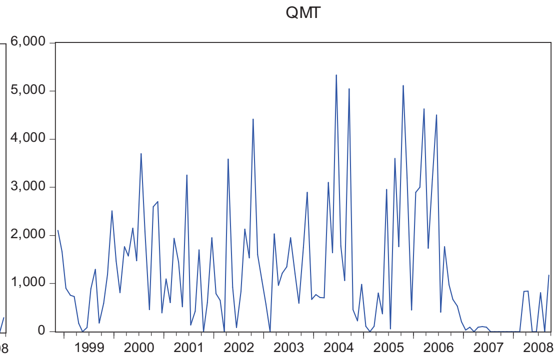

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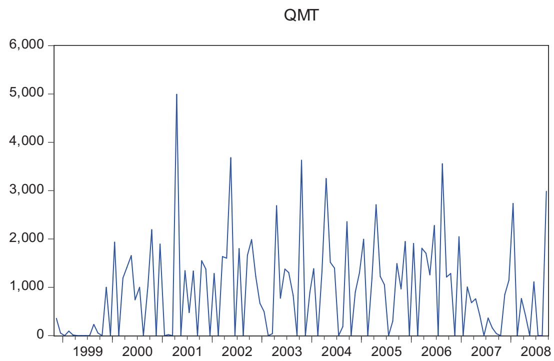

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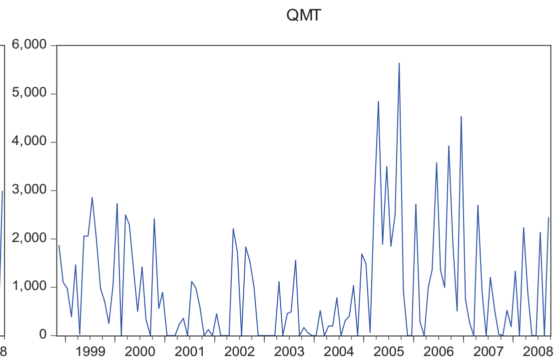

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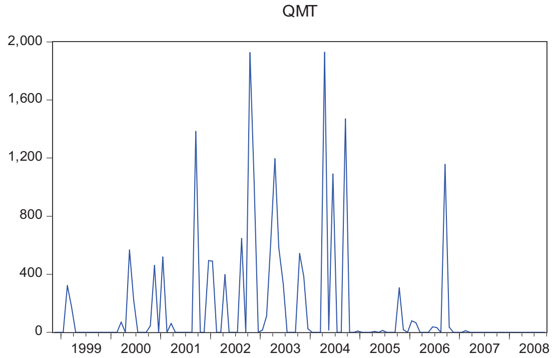

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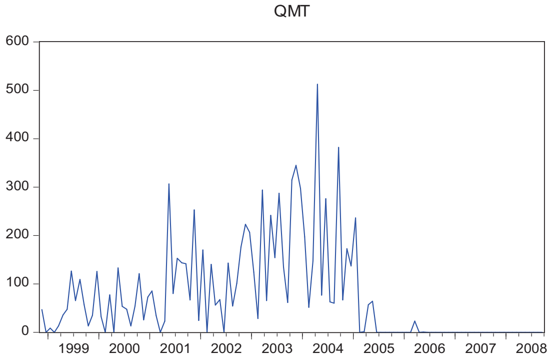

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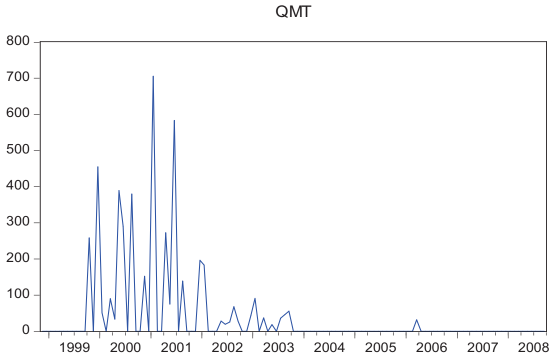

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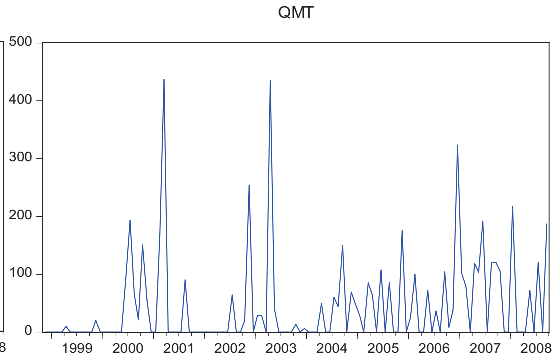

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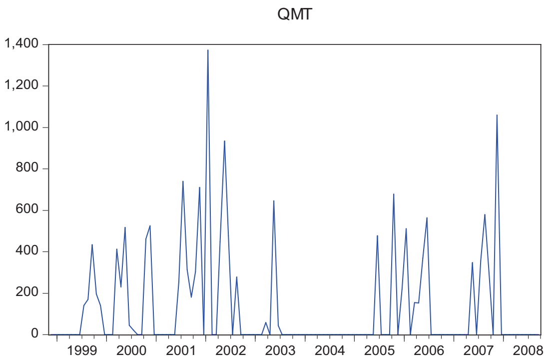

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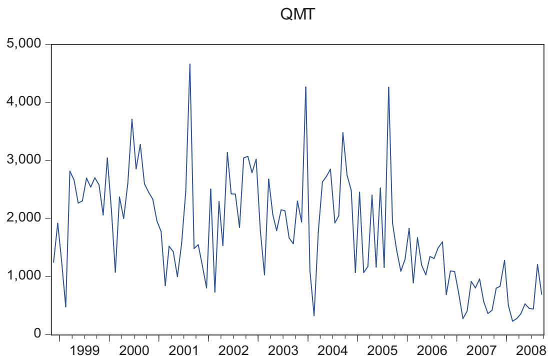

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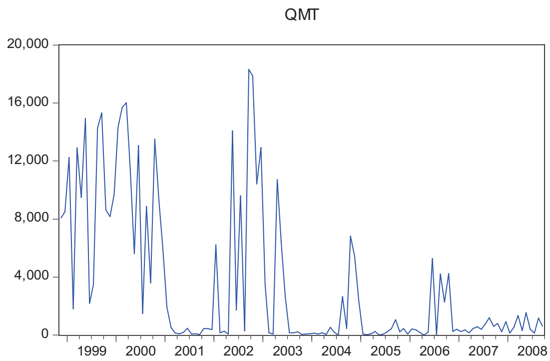
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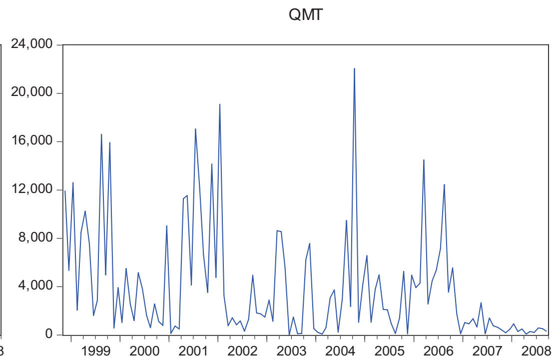
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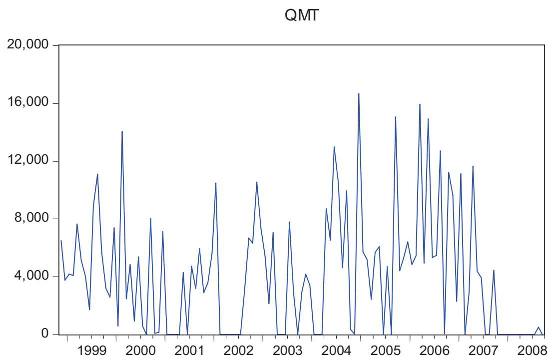
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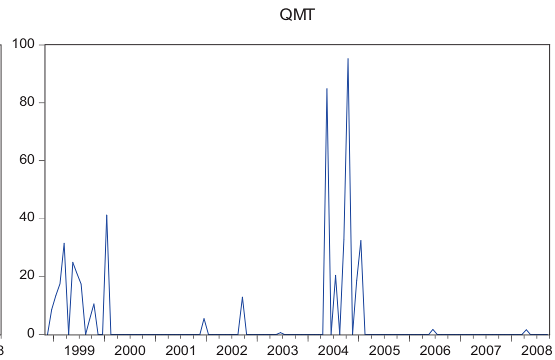
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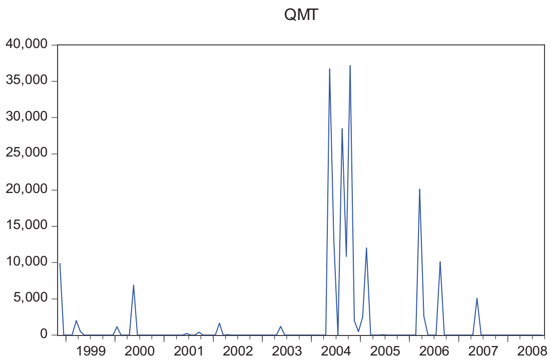
2.3.6 Middle East (Turkey)

1B



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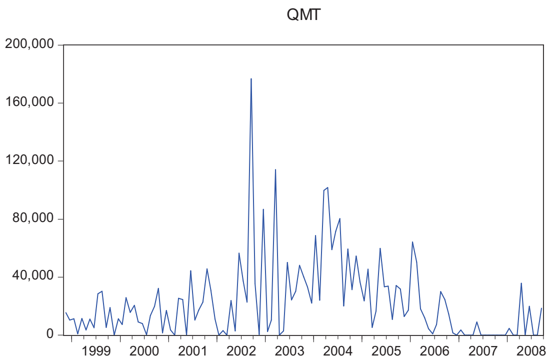

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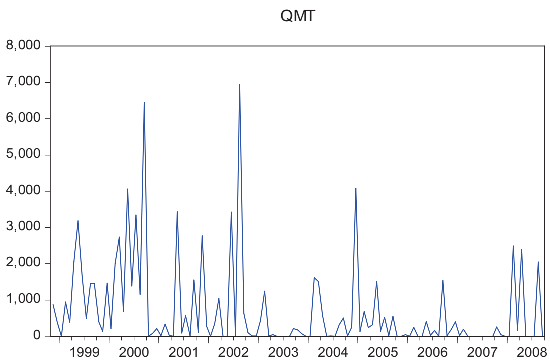

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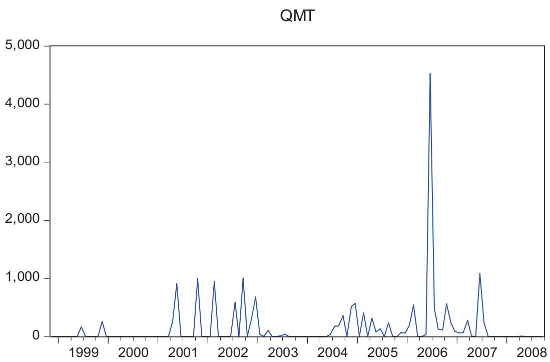

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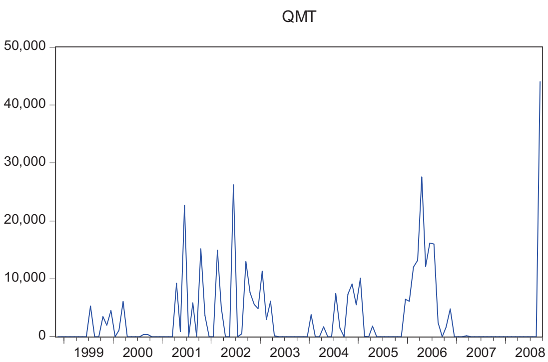

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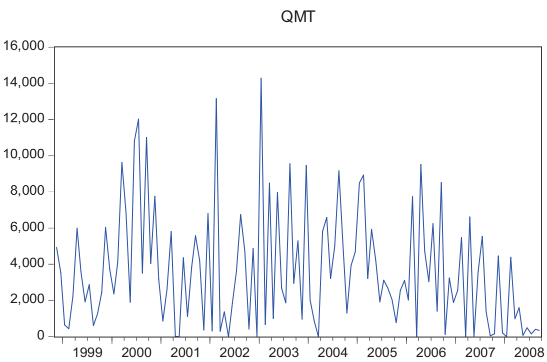

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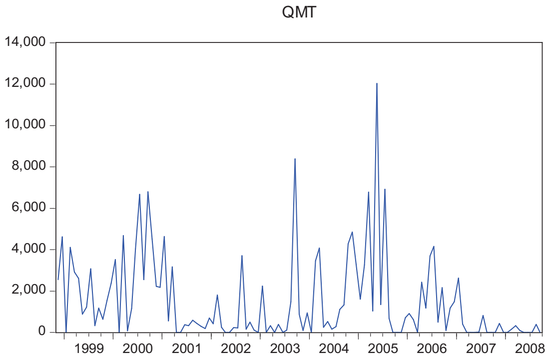

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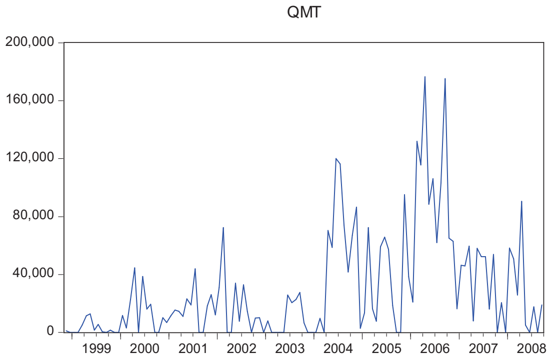

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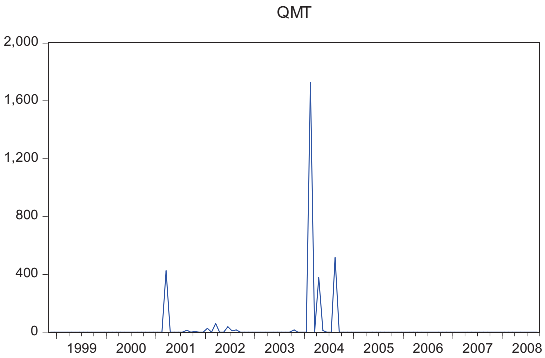

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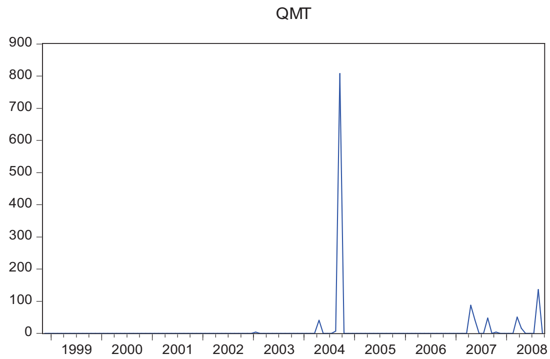

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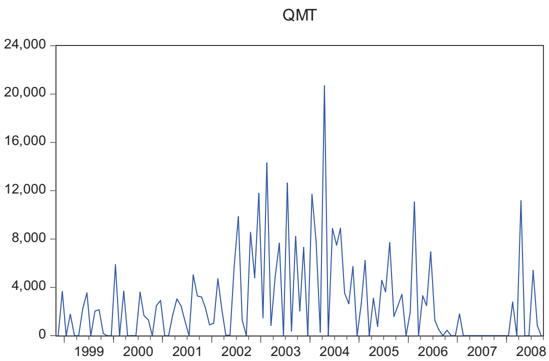

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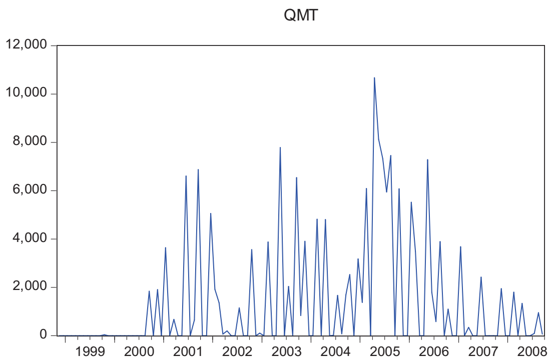

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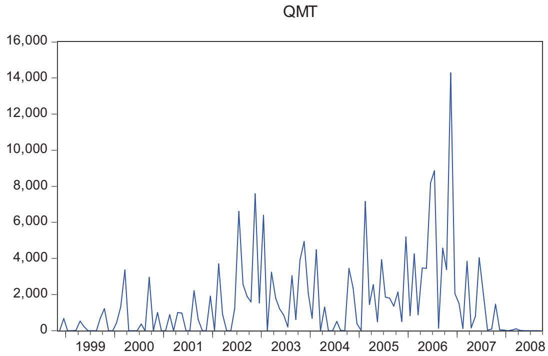

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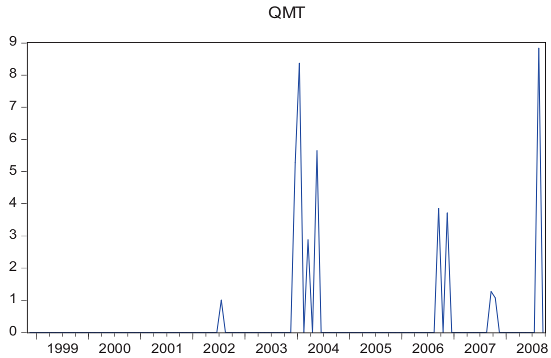

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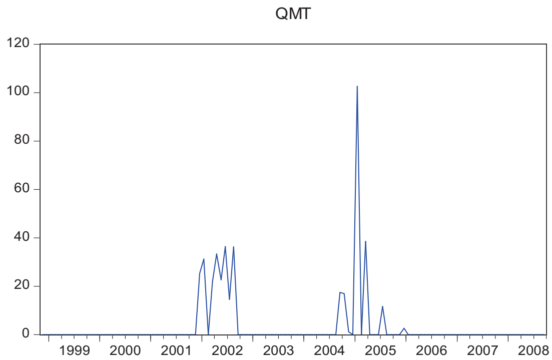

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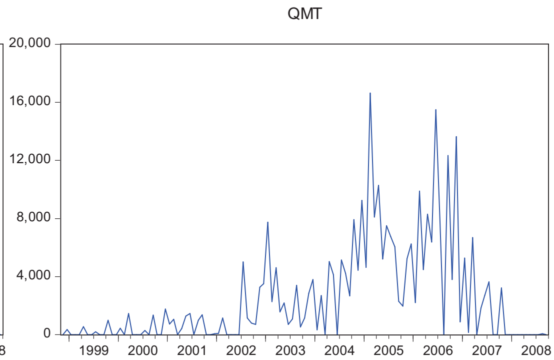

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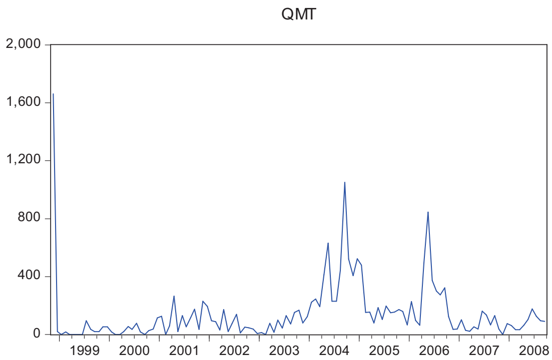

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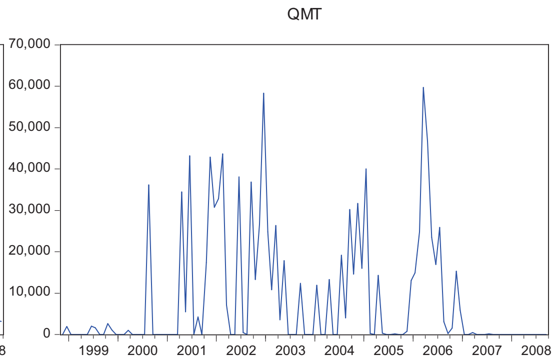

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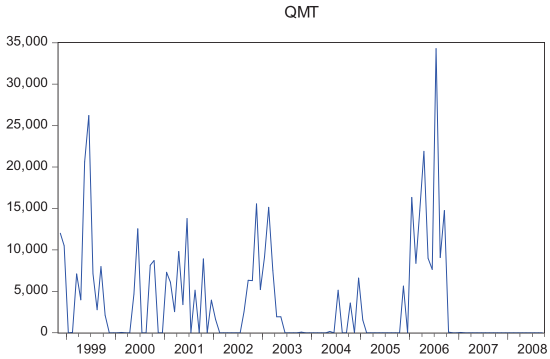
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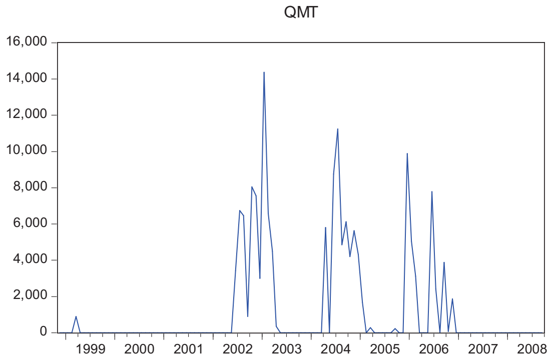
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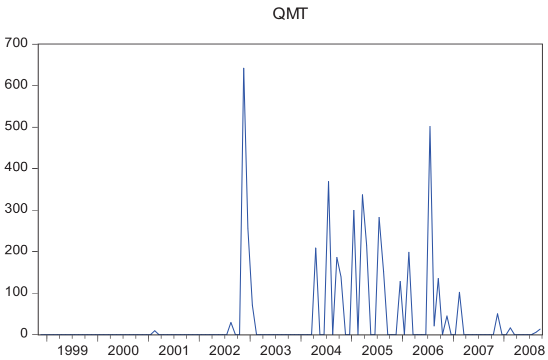
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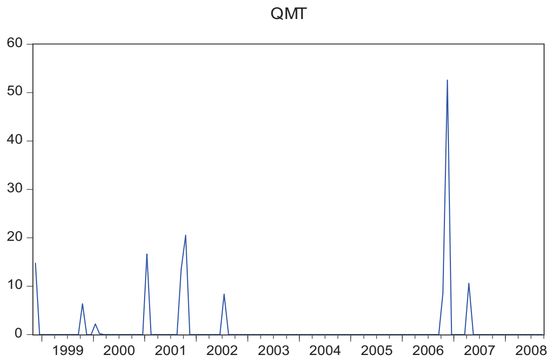
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2.3.7 Asia

2.3.7.1 China

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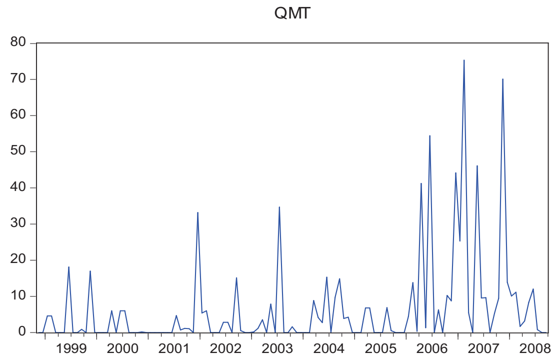

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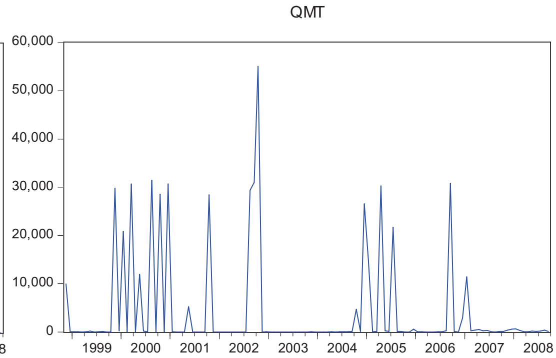

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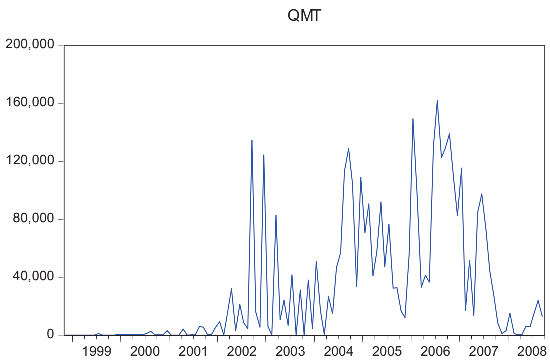

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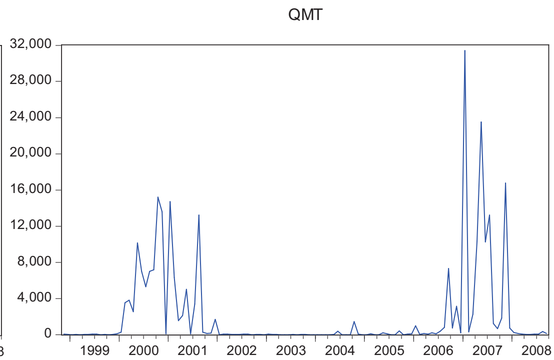

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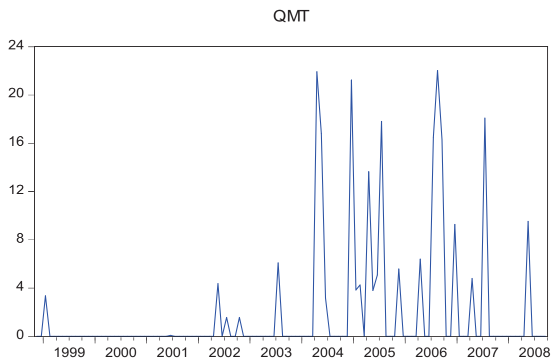

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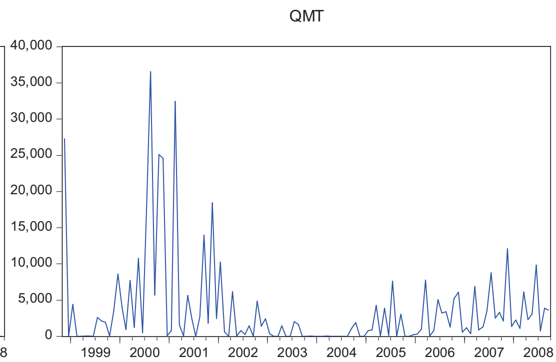

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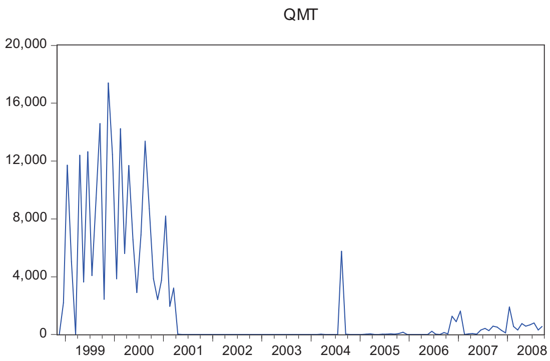
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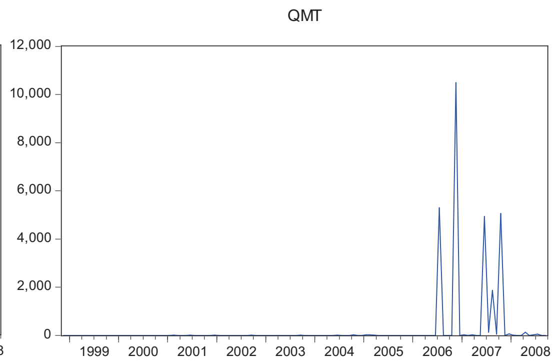
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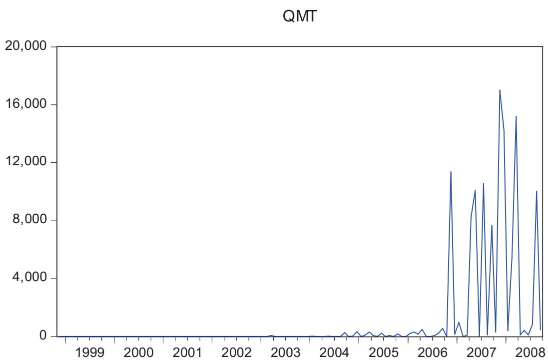
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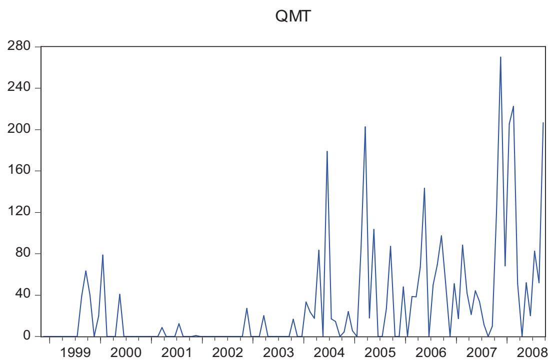
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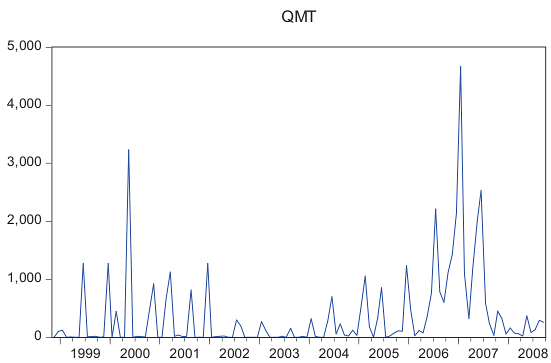
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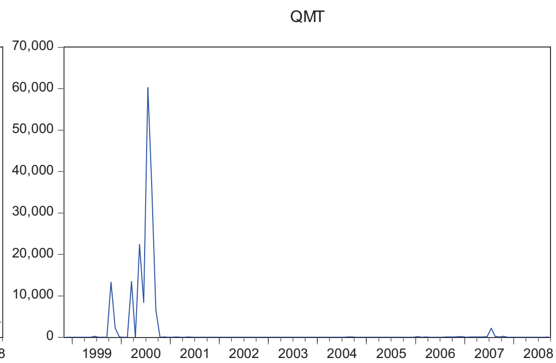
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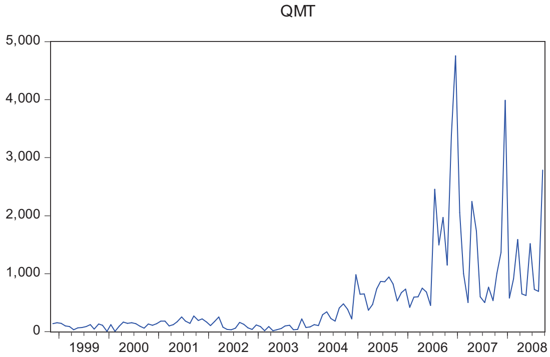

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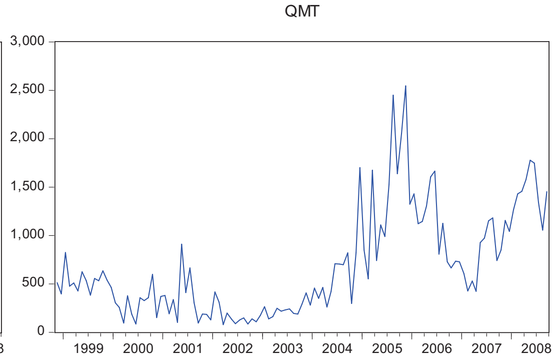

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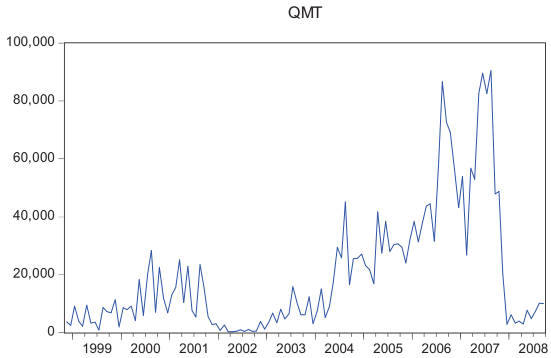

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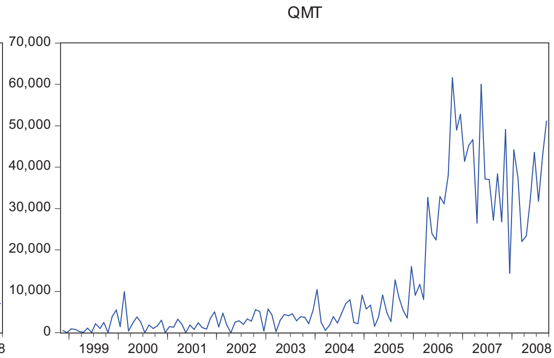

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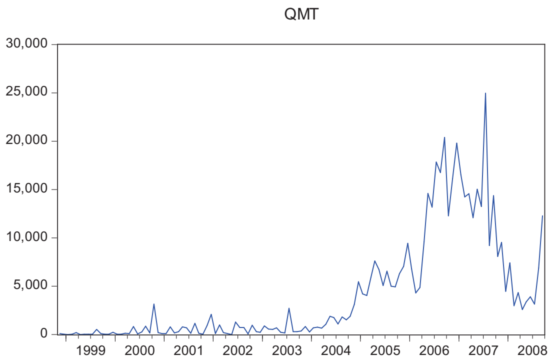

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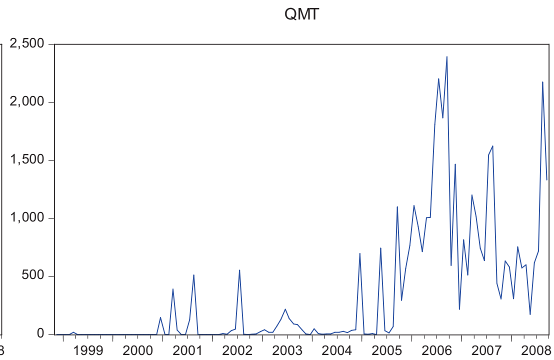

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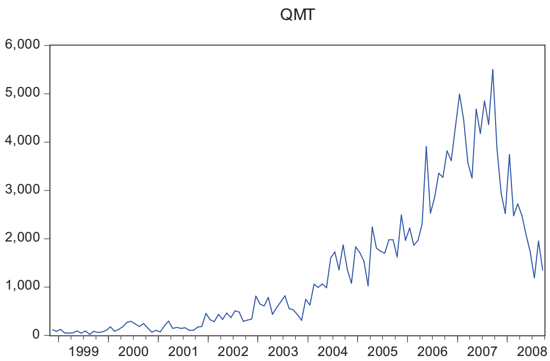

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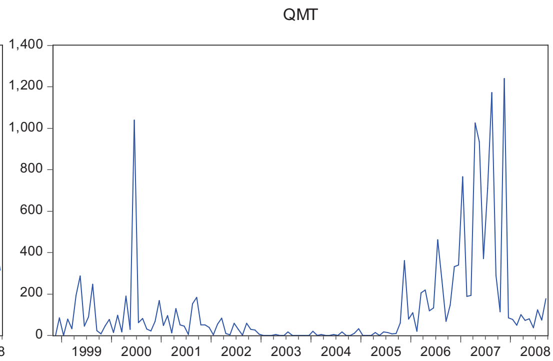

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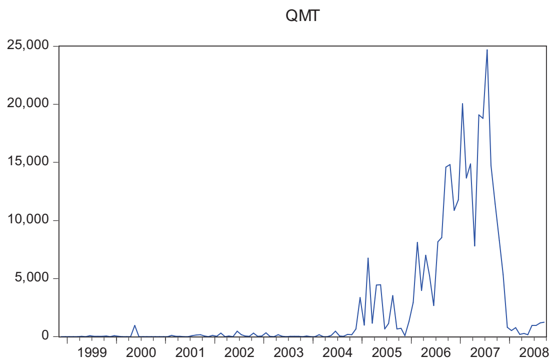

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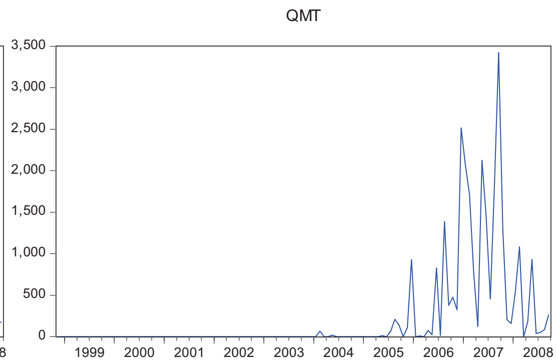

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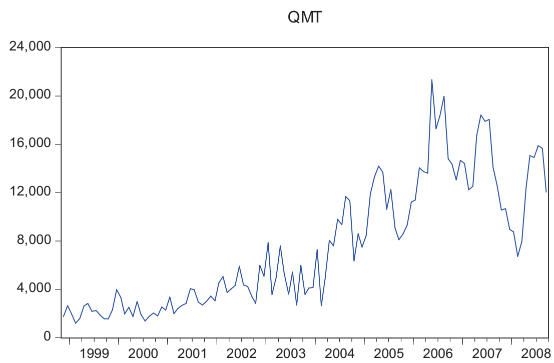

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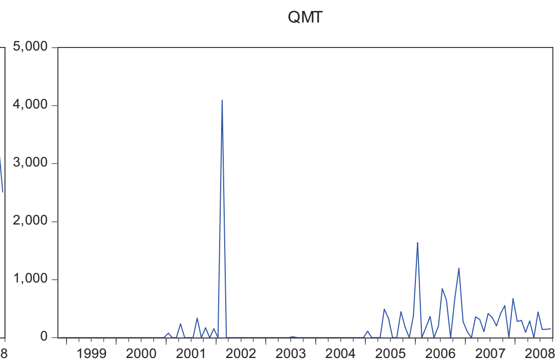

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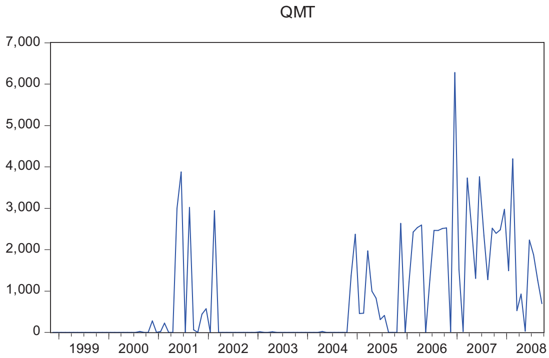

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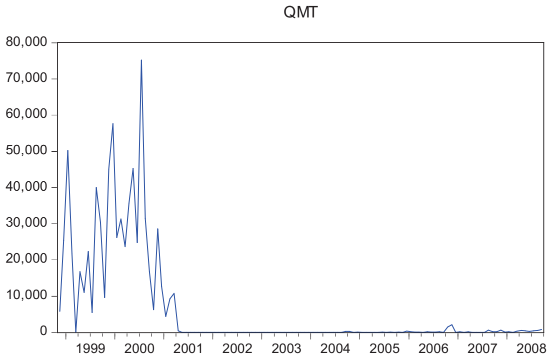

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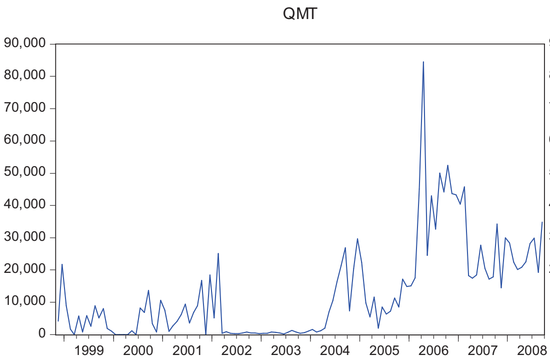

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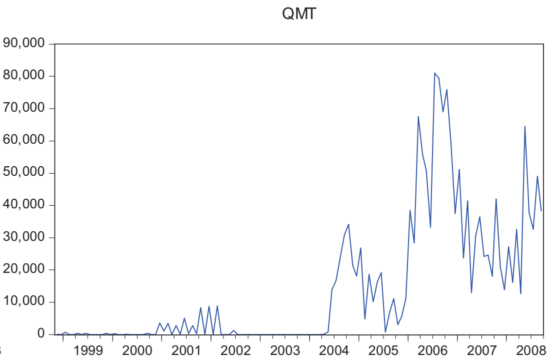
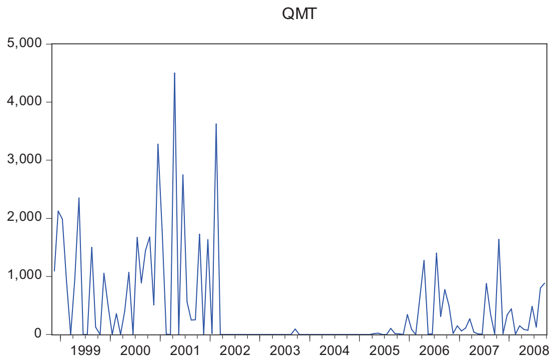


33B



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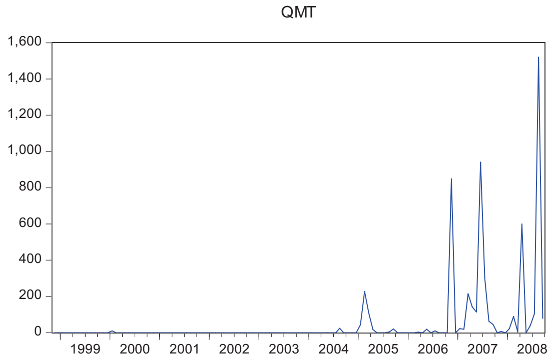

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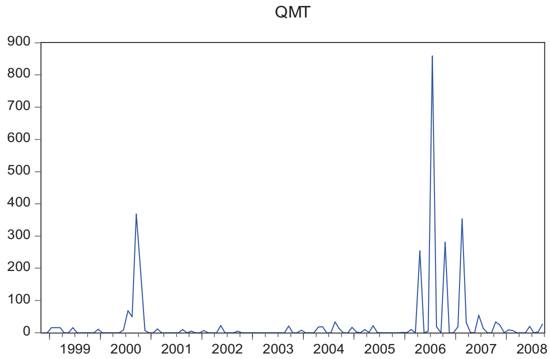

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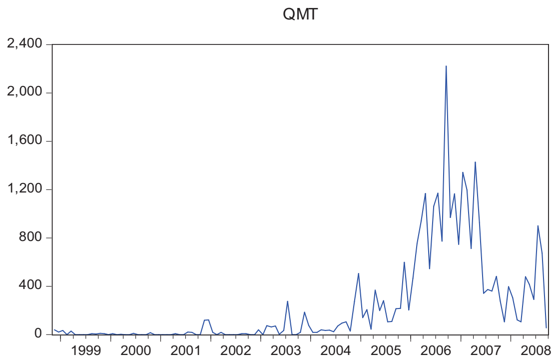

2.3.7.2 Japan

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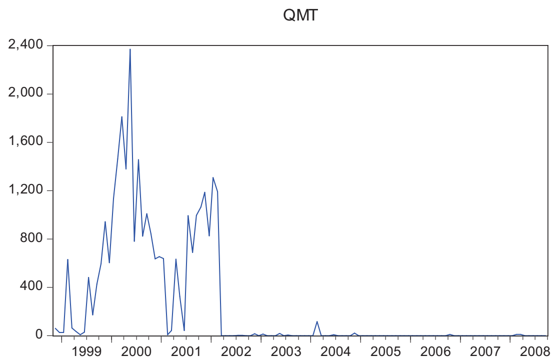

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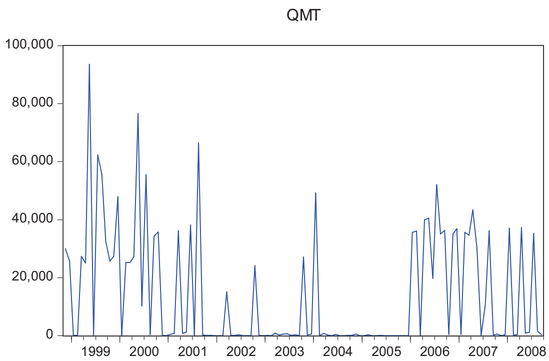

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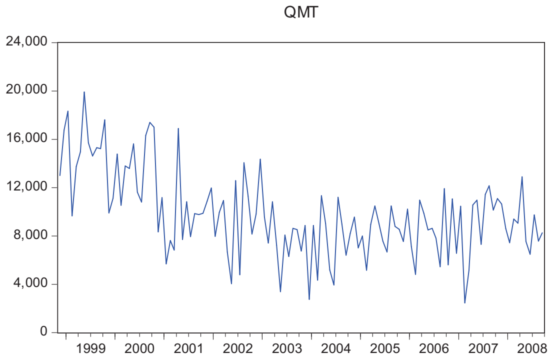
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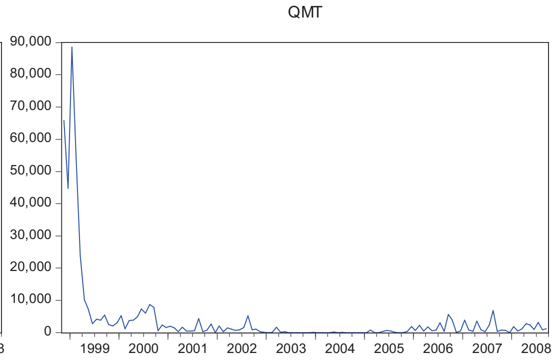
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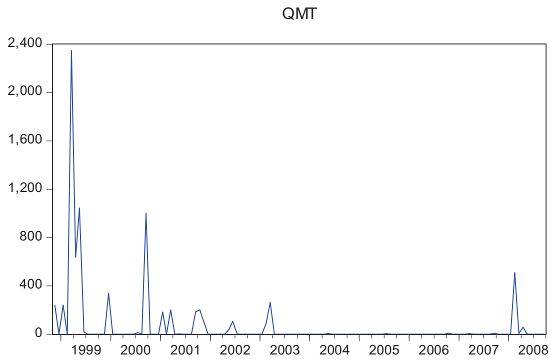
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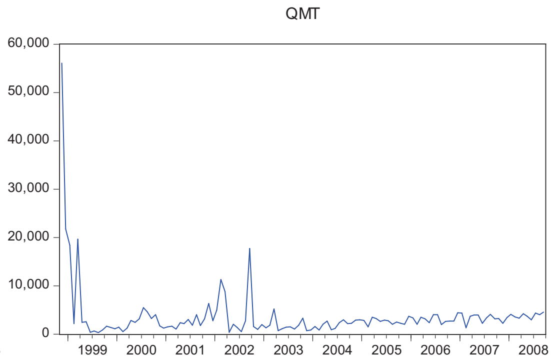
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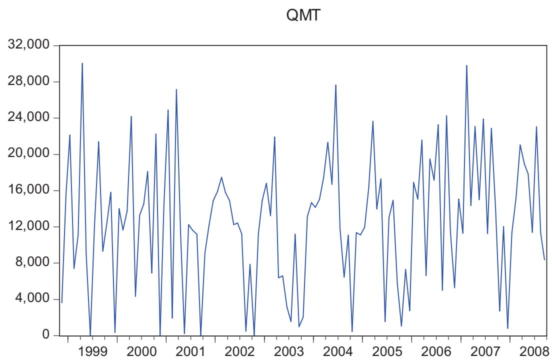
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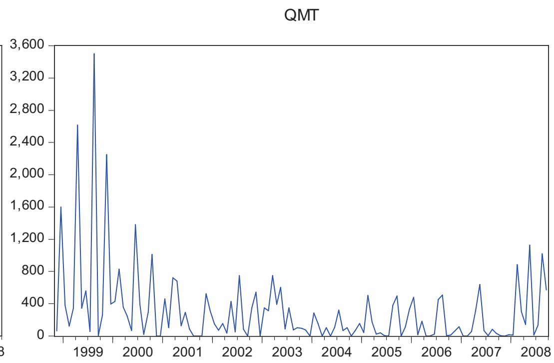
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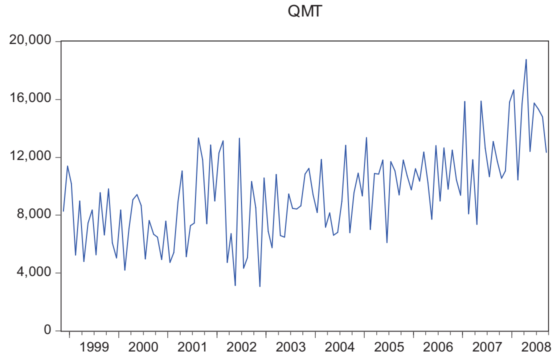

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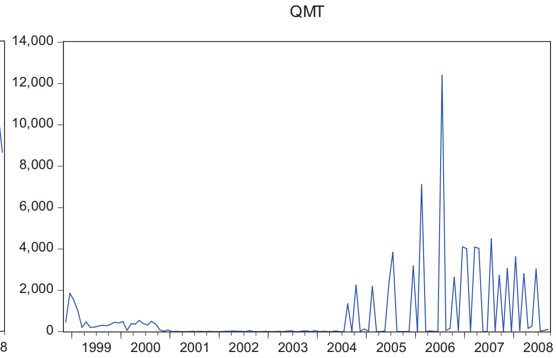

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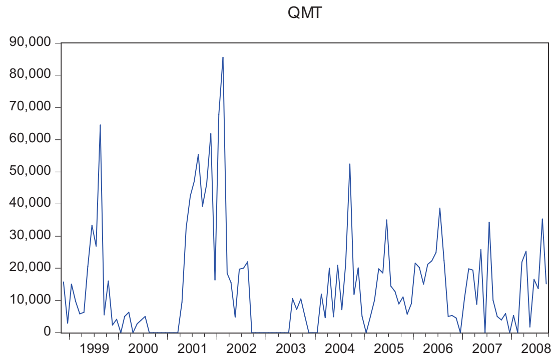

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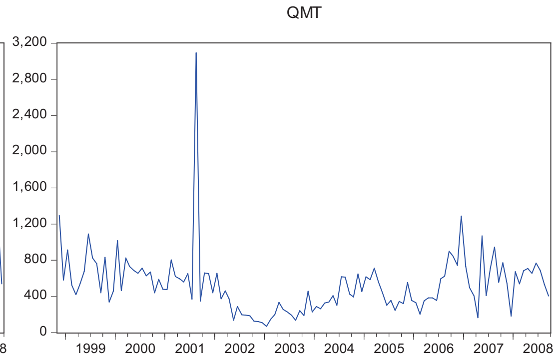

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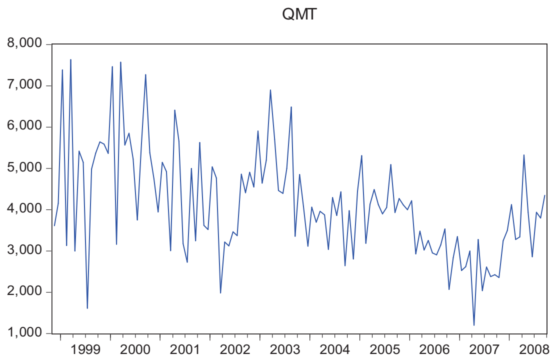

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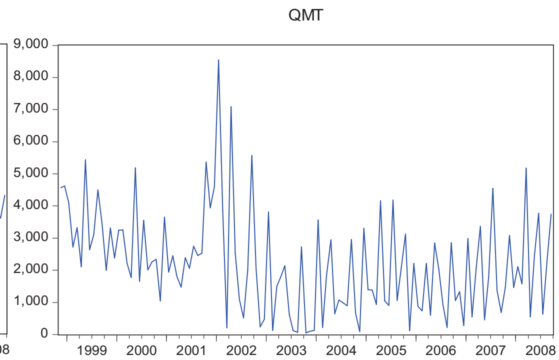

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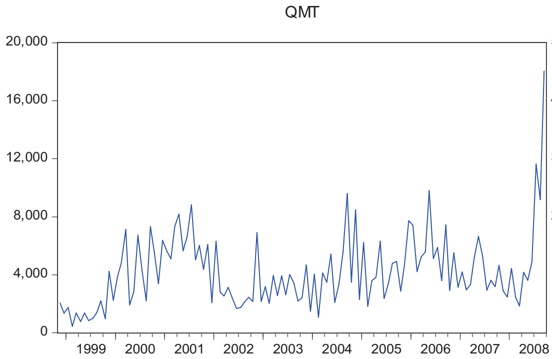

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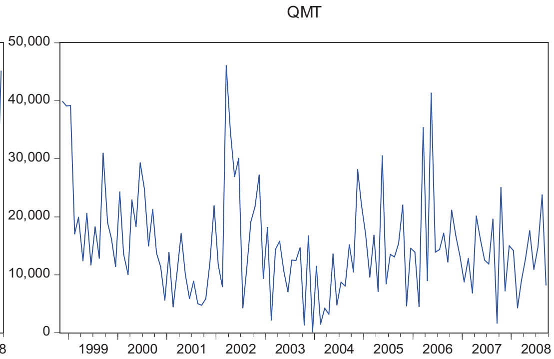

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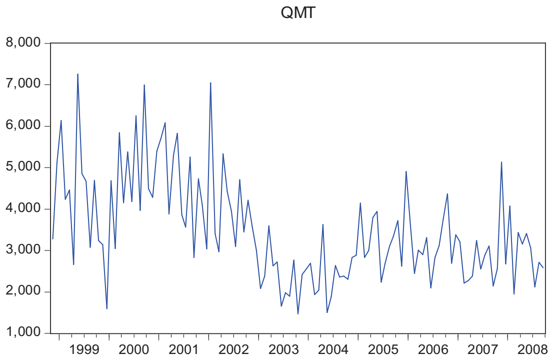

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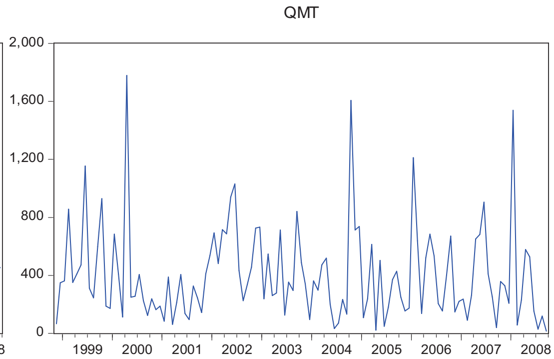

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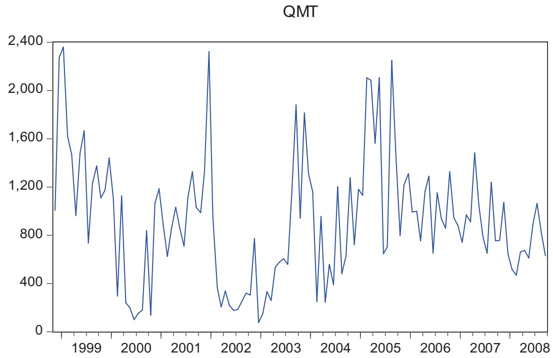

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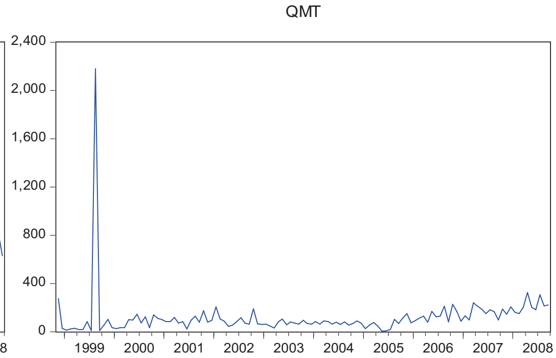

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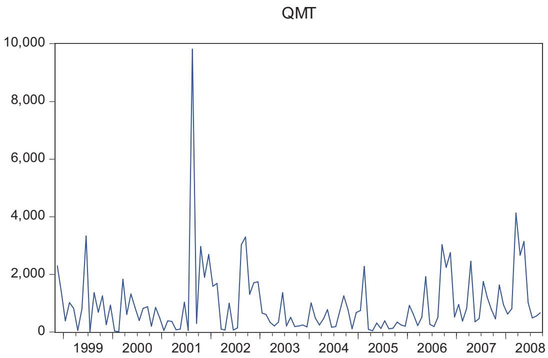

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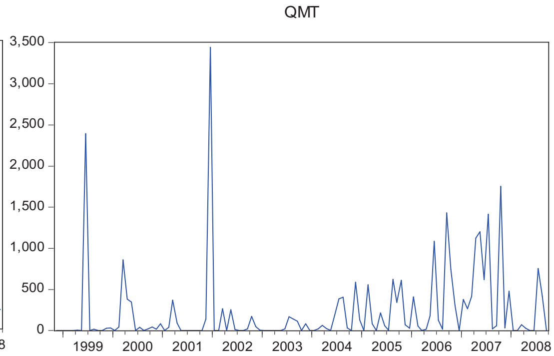

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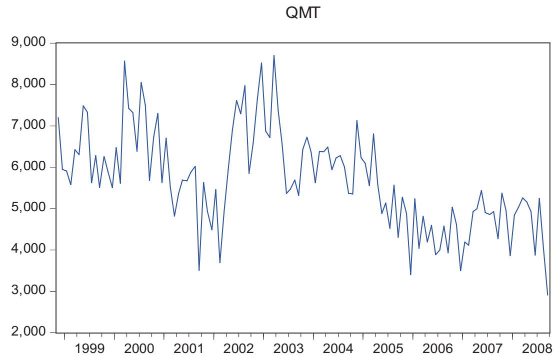

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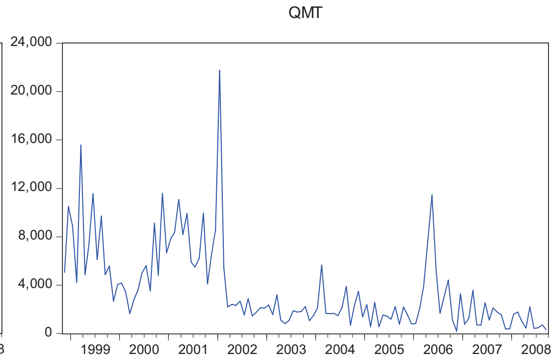

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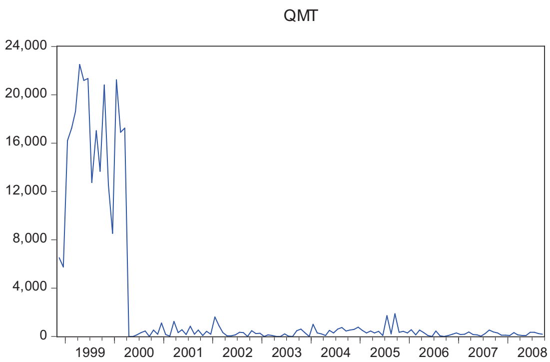

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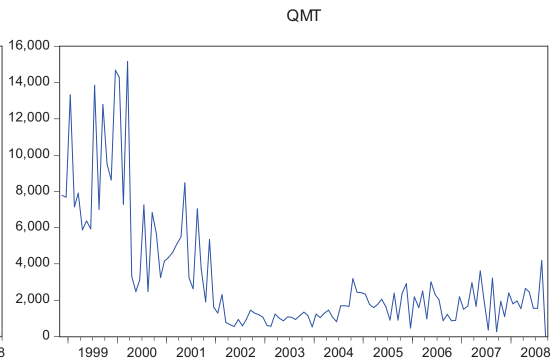

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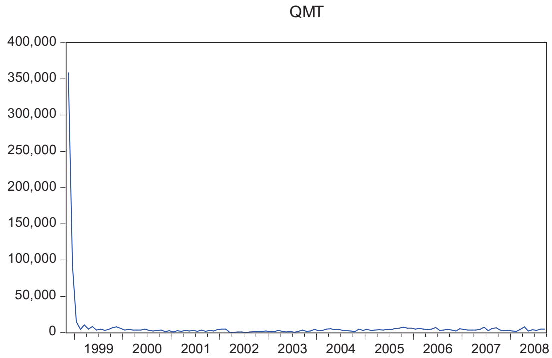

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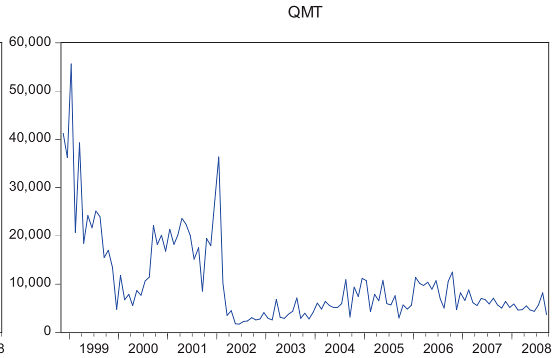

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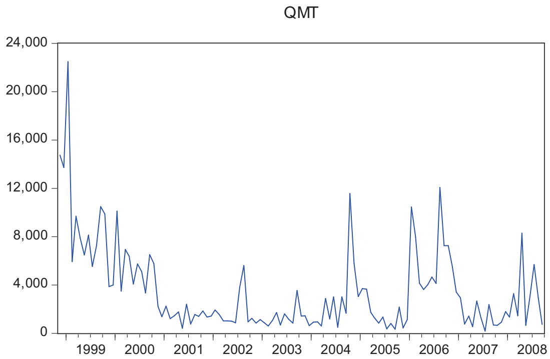

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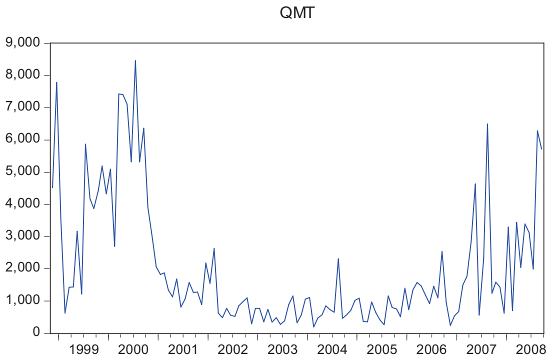

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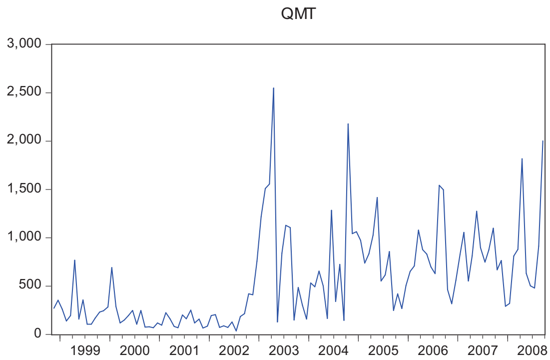

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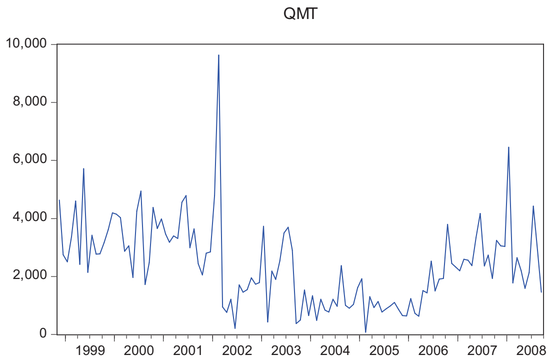

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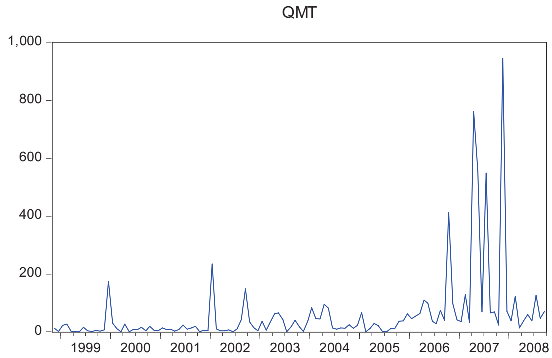

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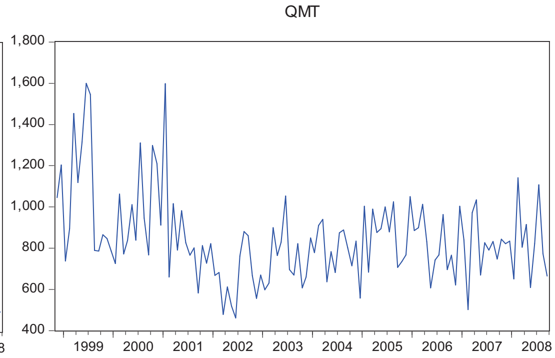

2.3.7.3 South Korea

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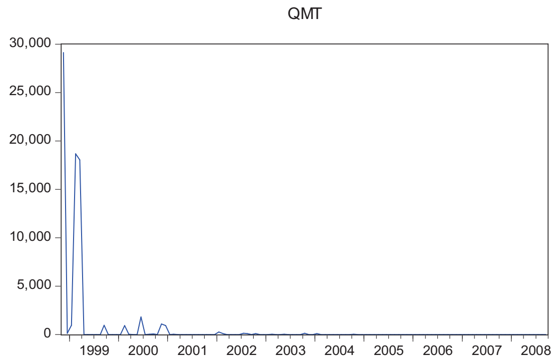

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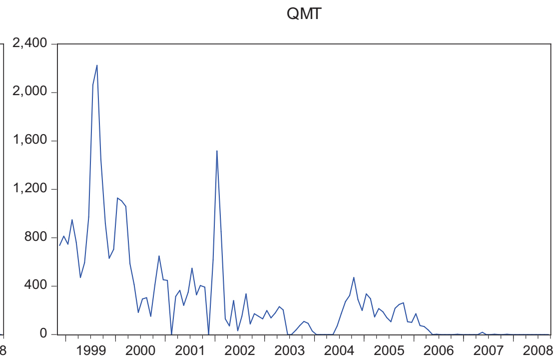

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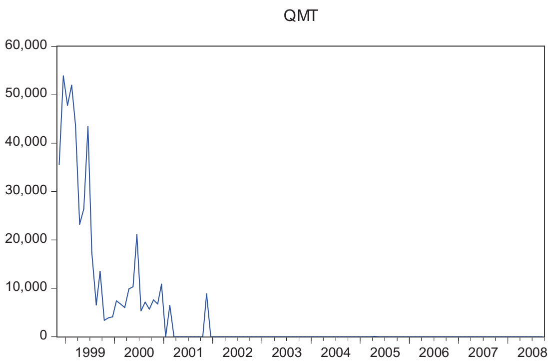

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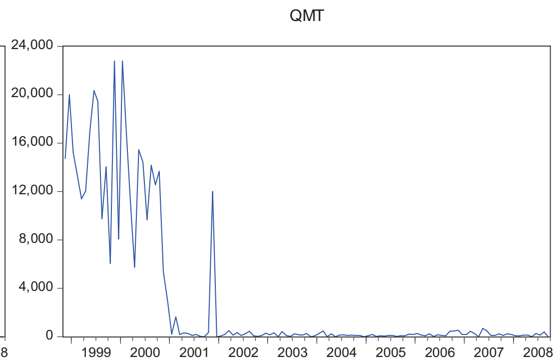

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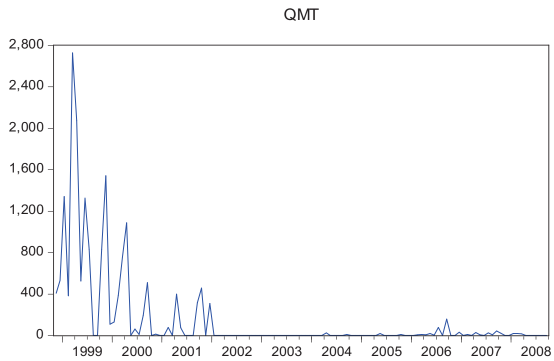

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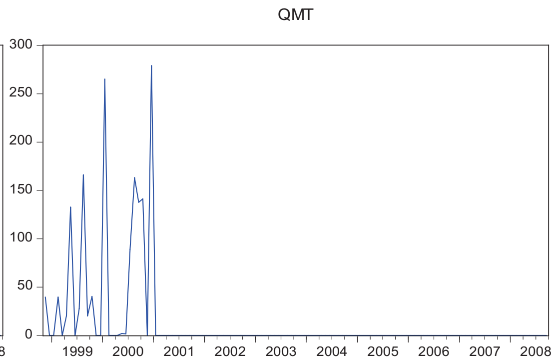

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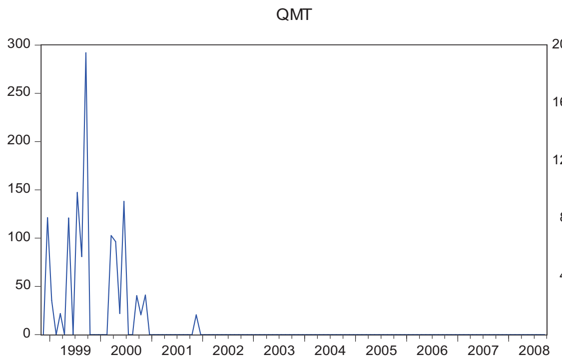

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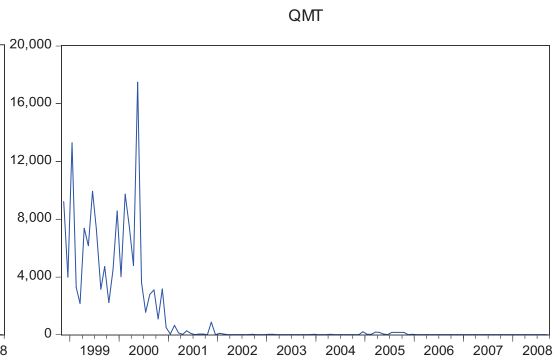

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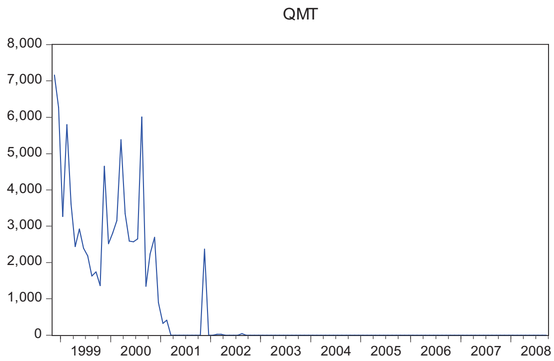

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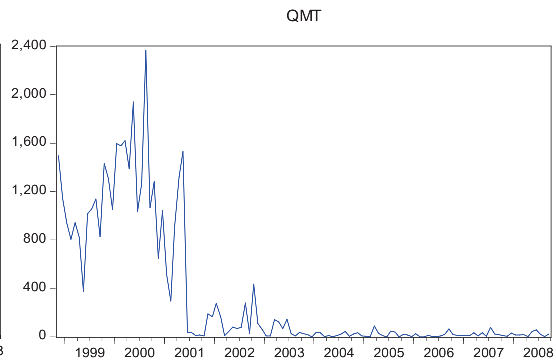

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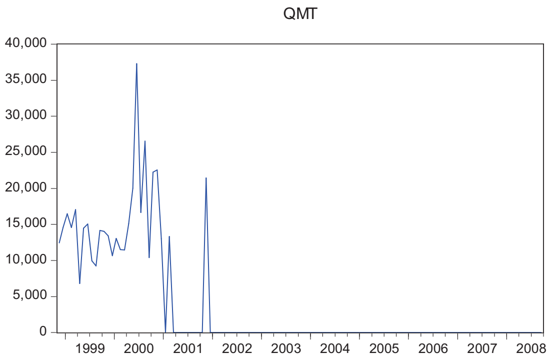

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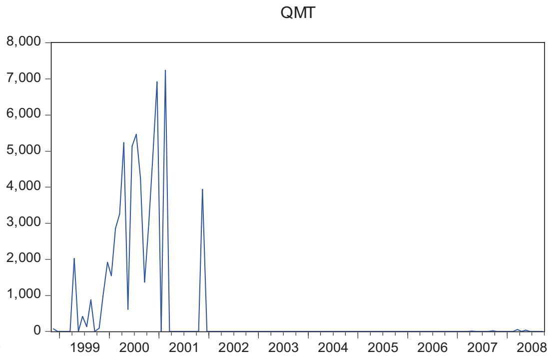

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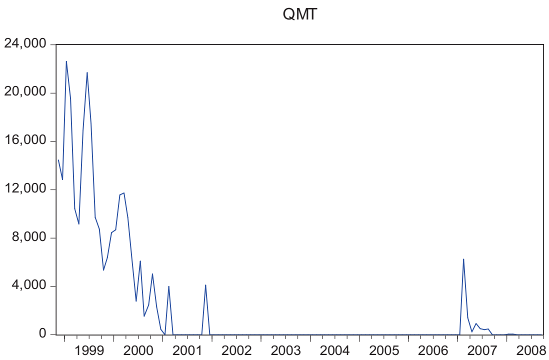

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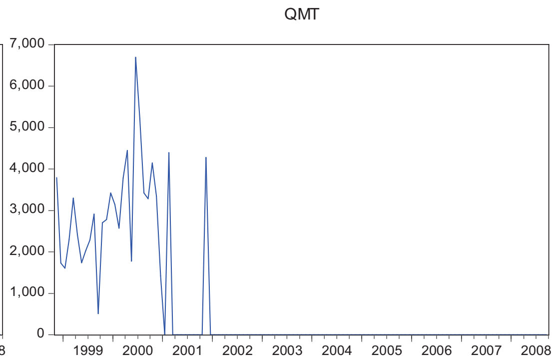

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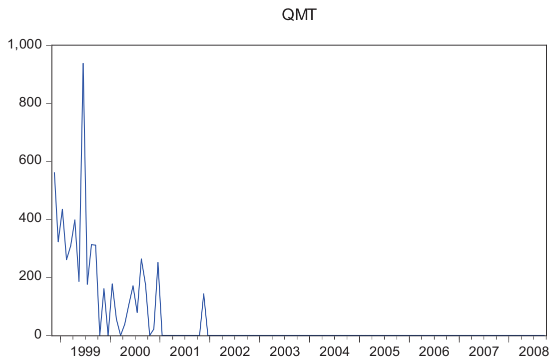

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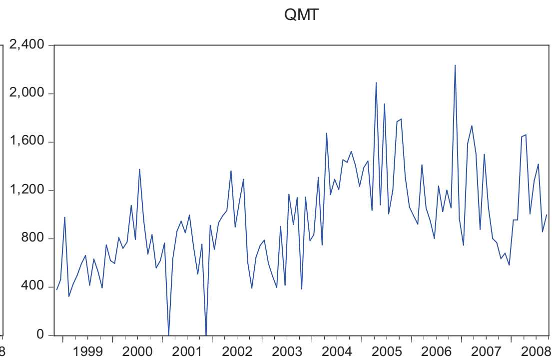

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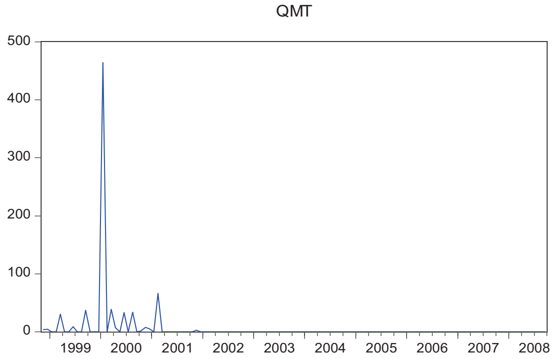

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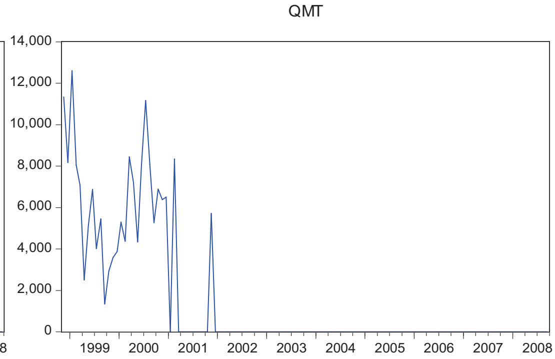

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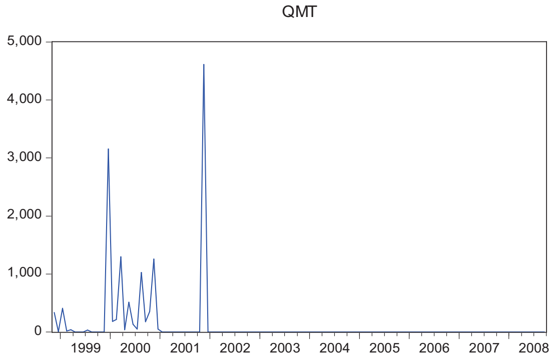

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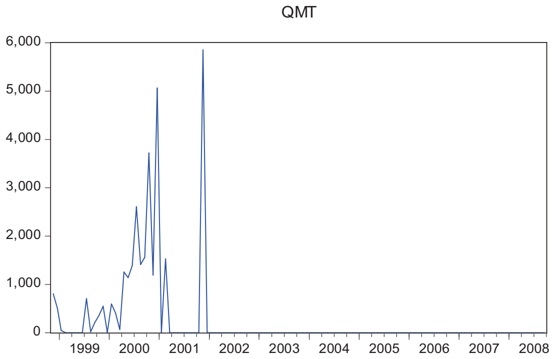

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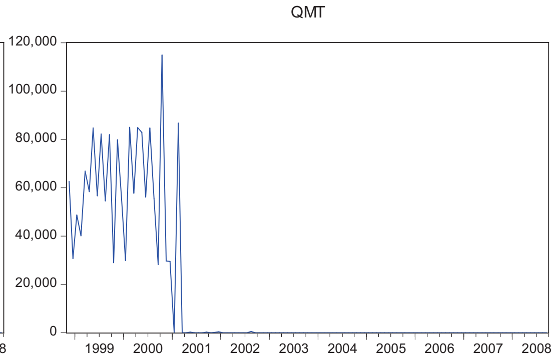

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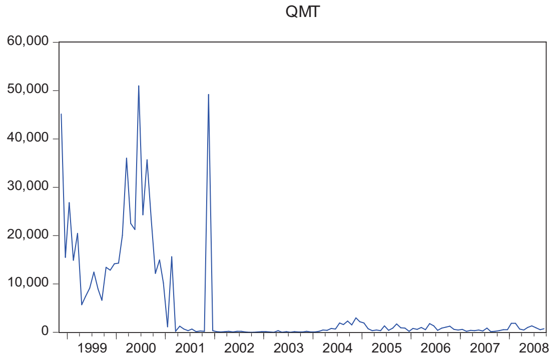

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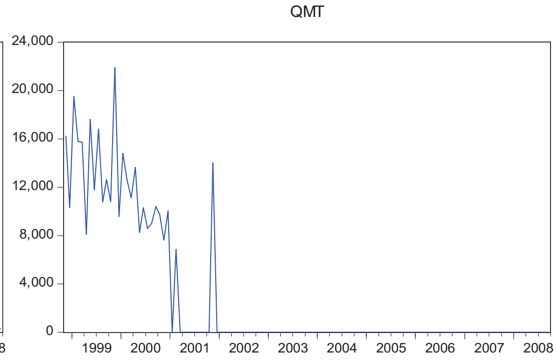

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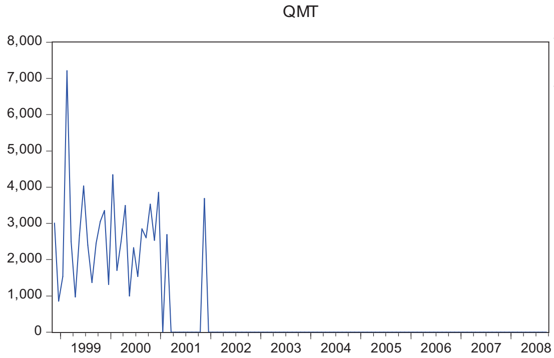

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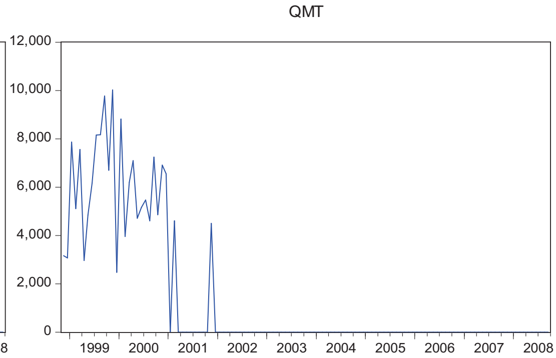

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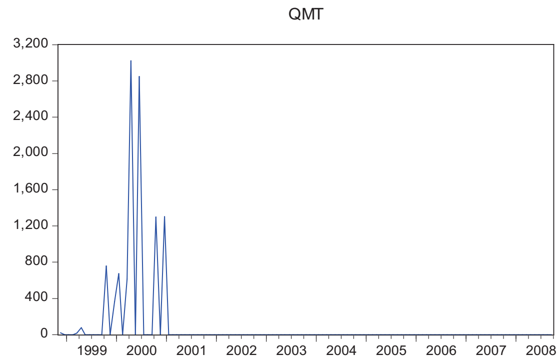

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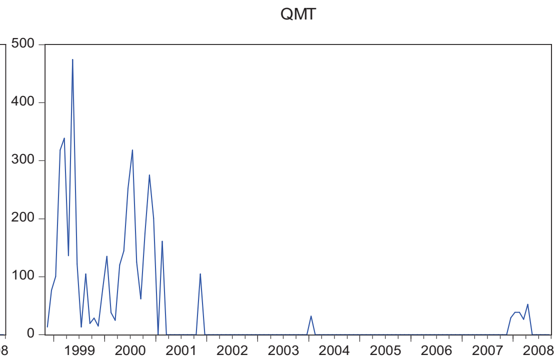

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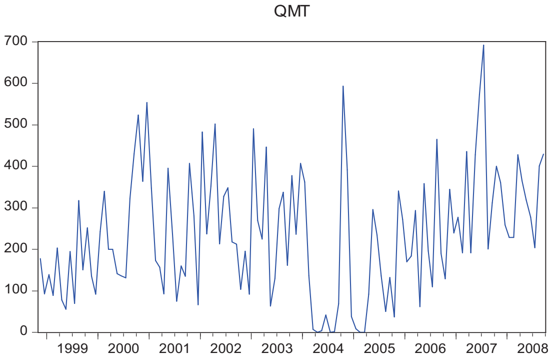

2.3.7.4 Taiwan

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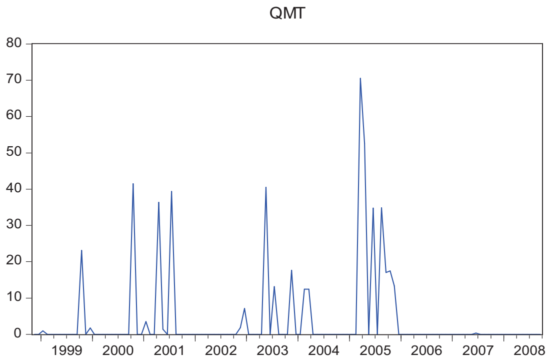

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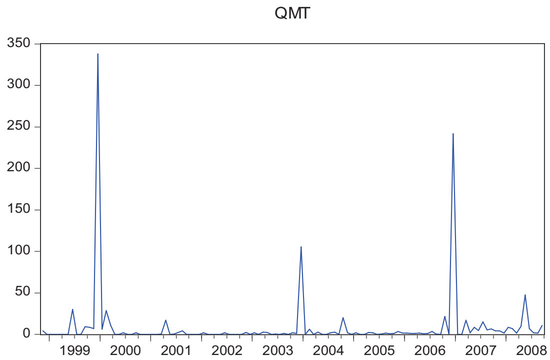

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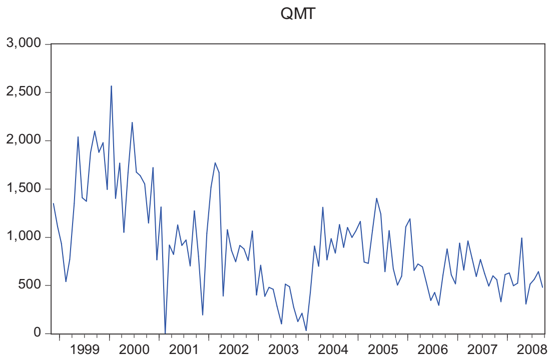
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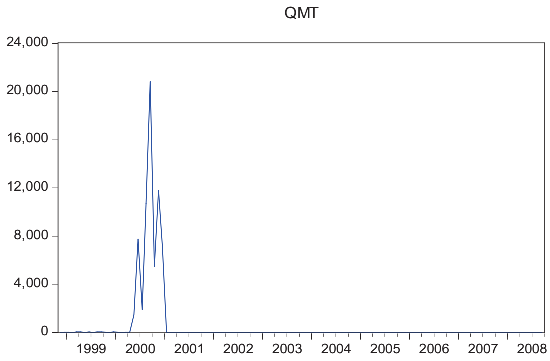
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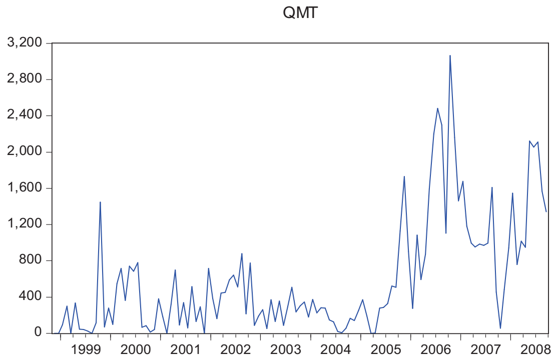
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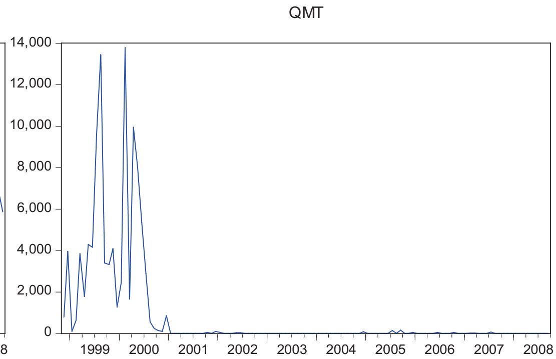
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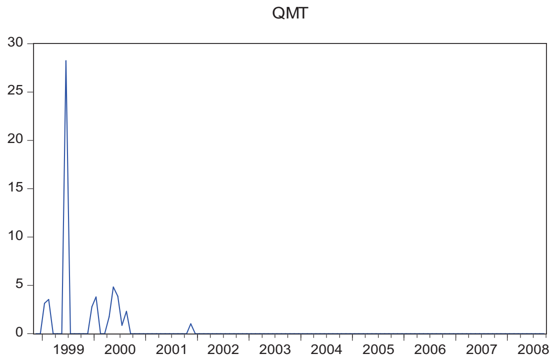
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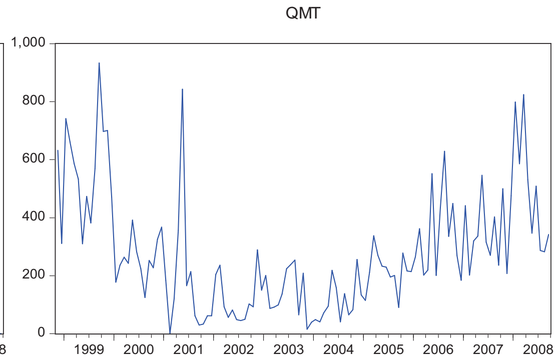
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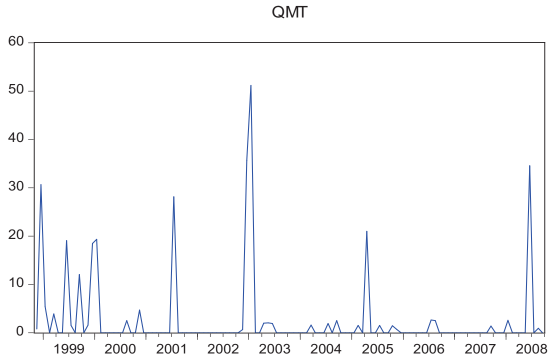

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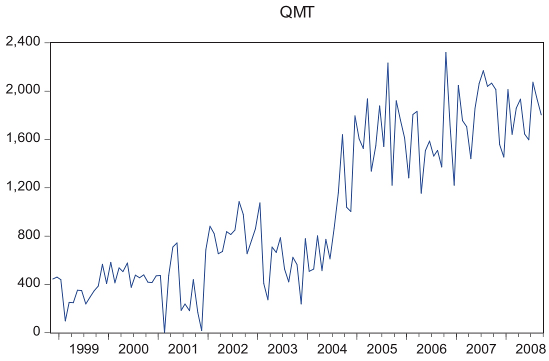

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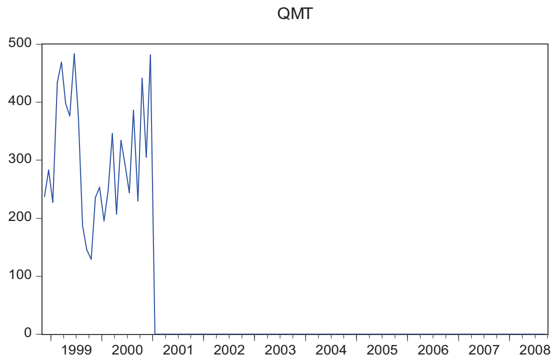

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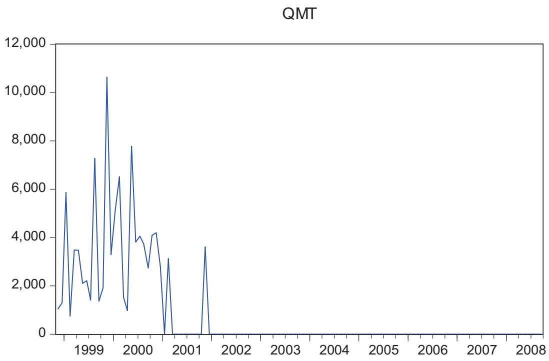

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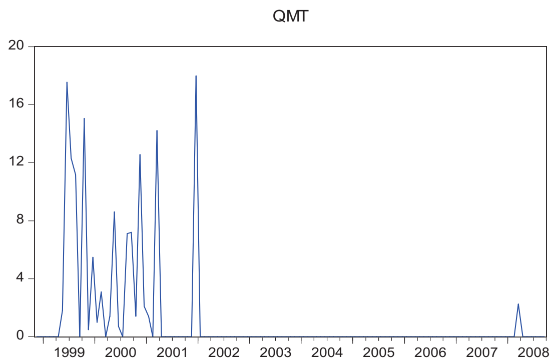

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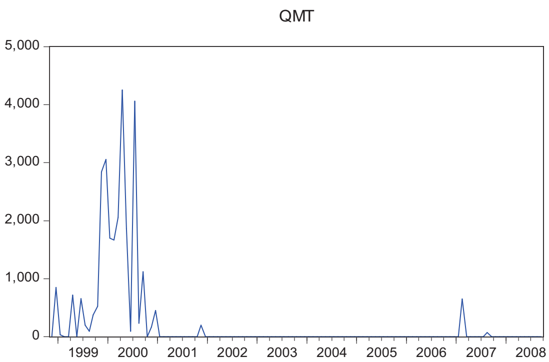

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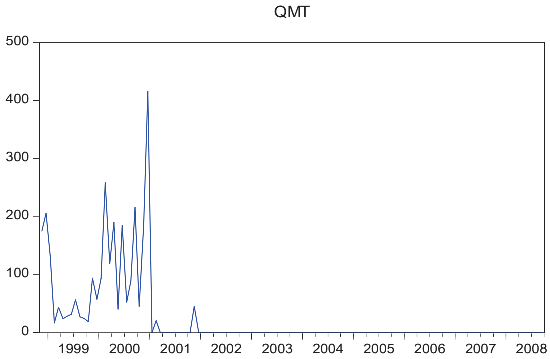

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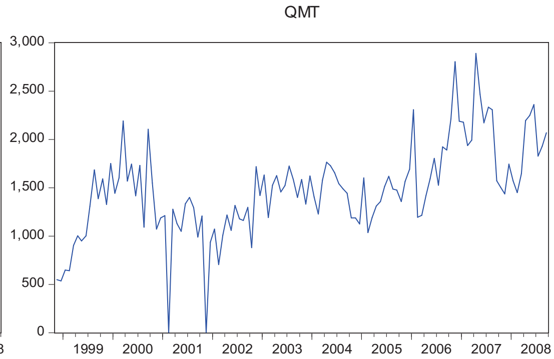

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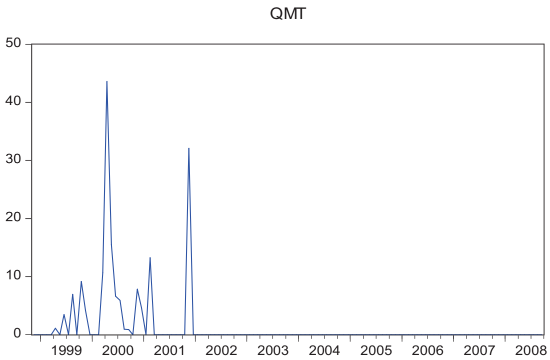

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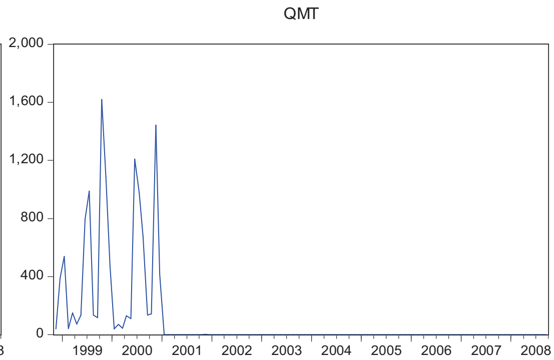

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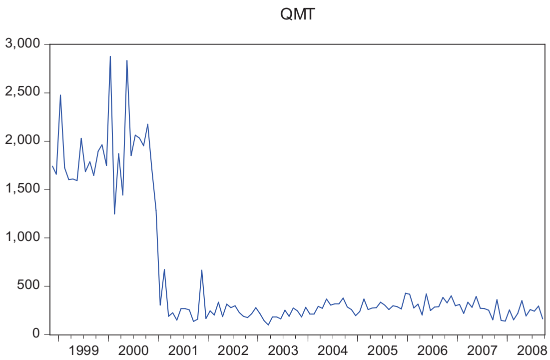

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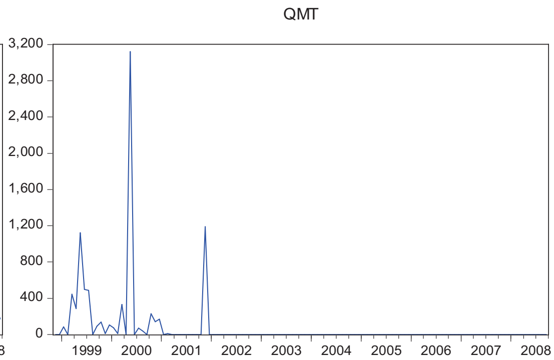

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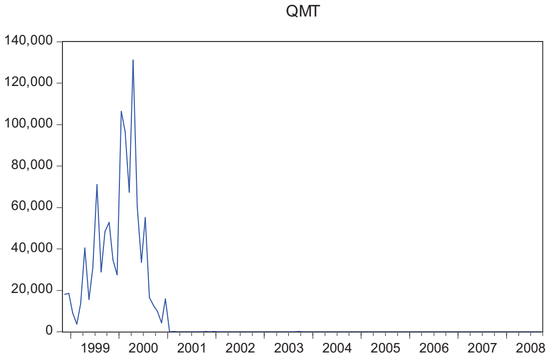

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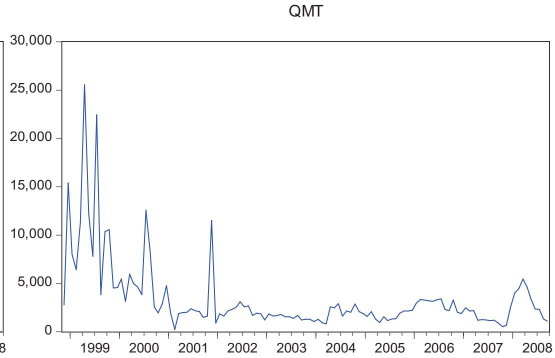

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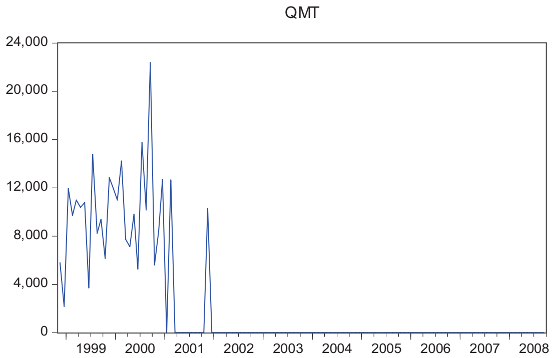

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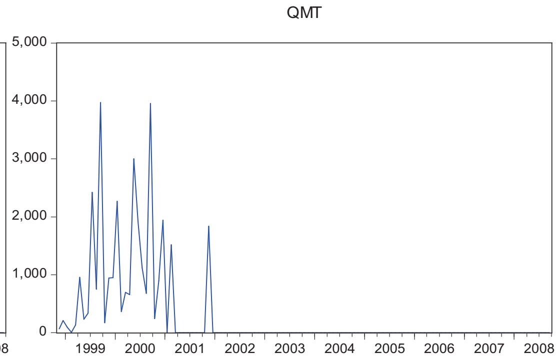

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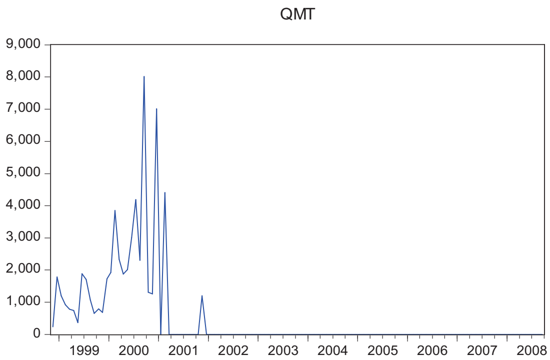

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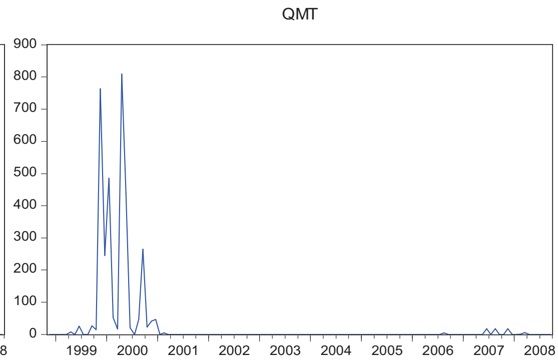

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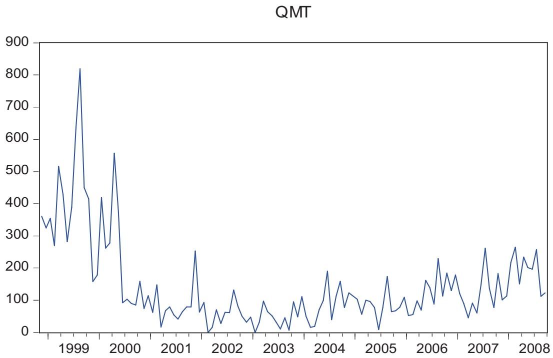
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2.3.8 Oceania (Australia)

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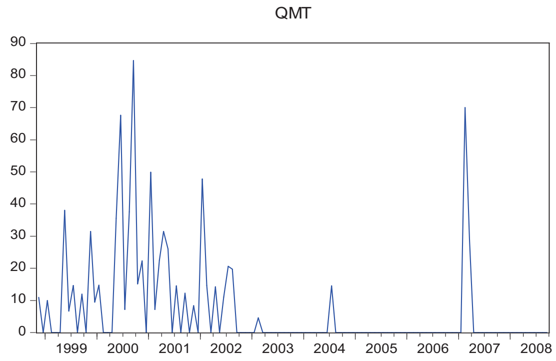

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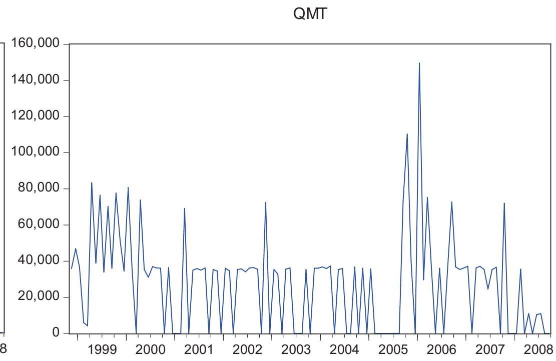

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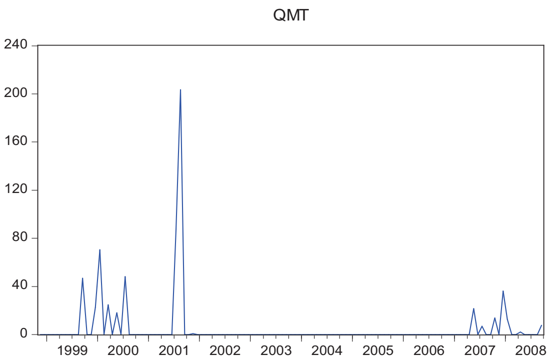

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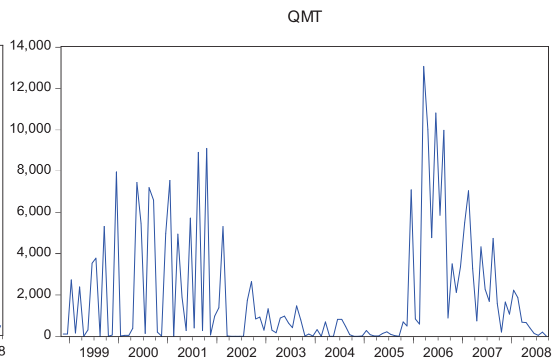

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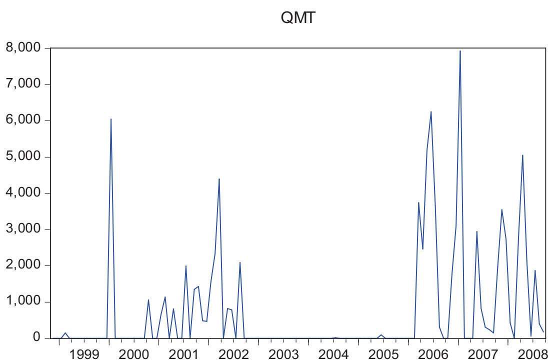

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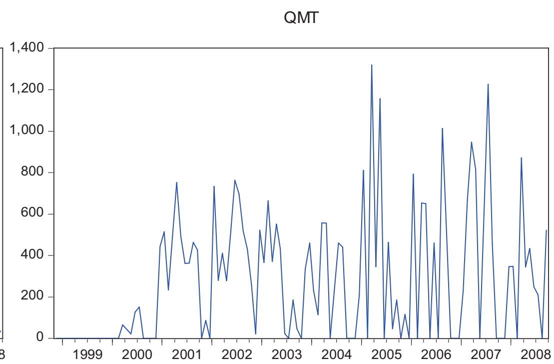

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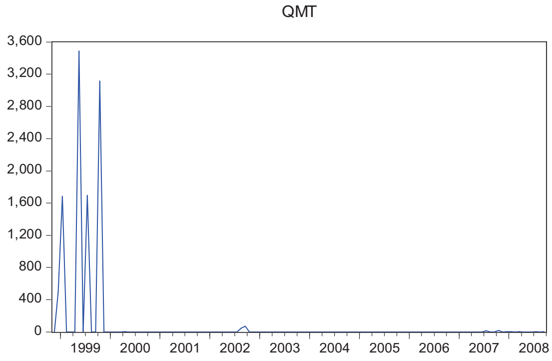

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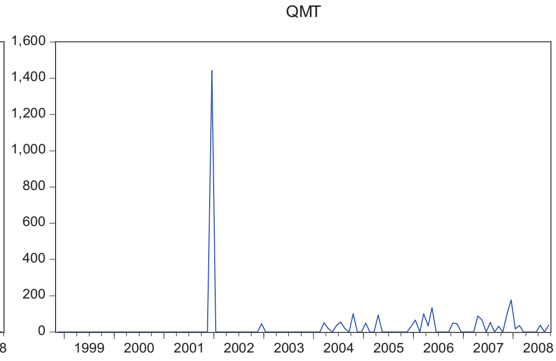

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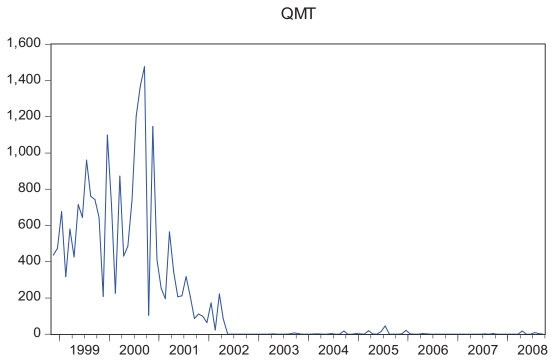

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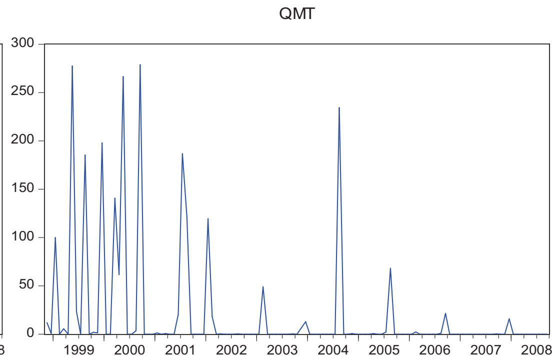

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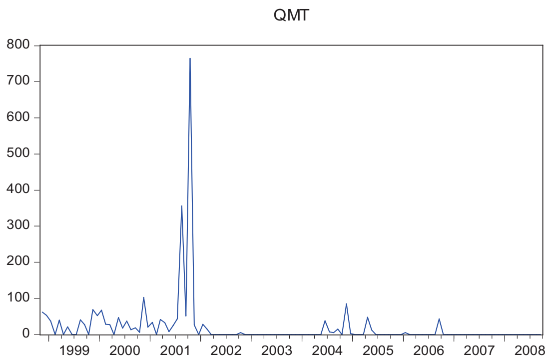

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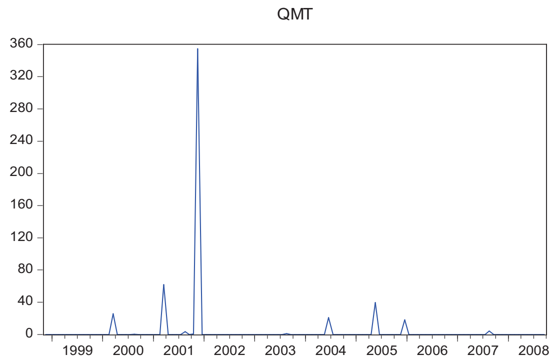

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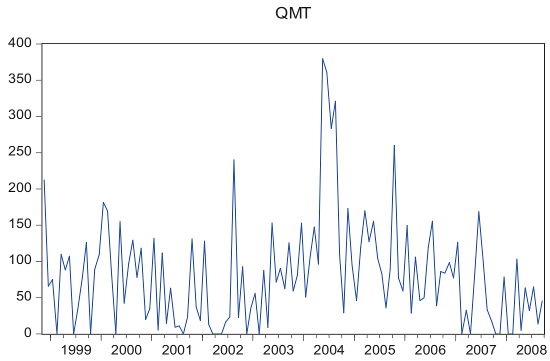

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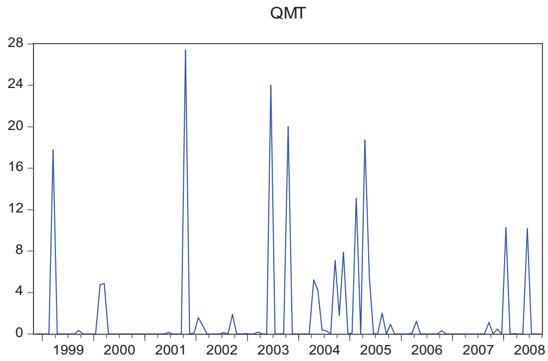

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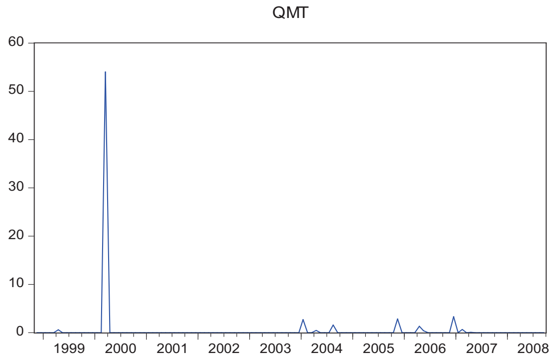

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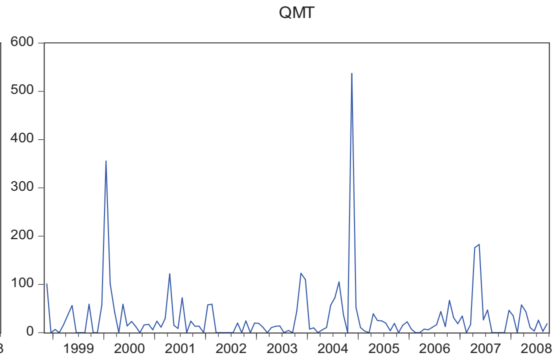

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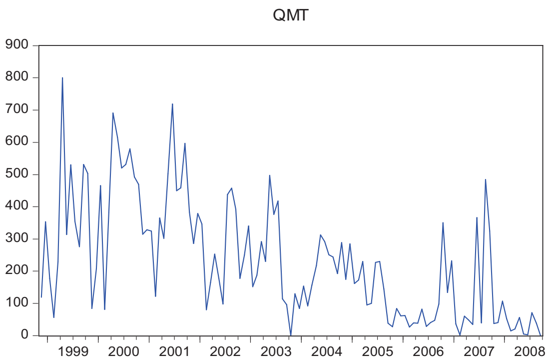

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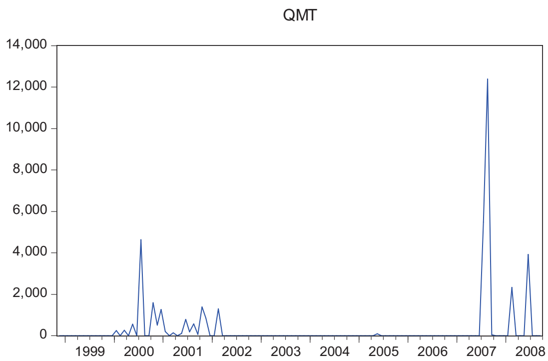

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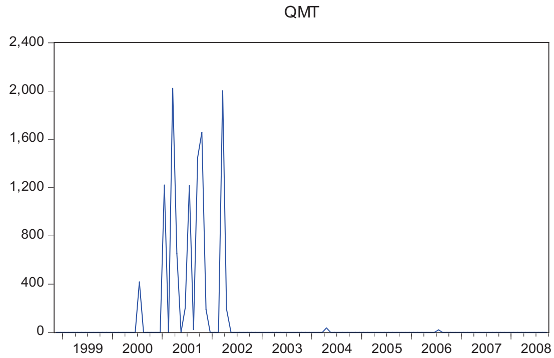

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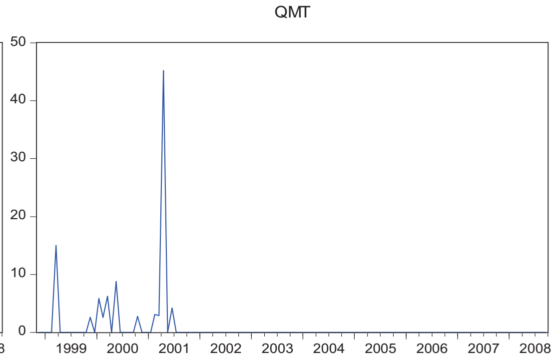

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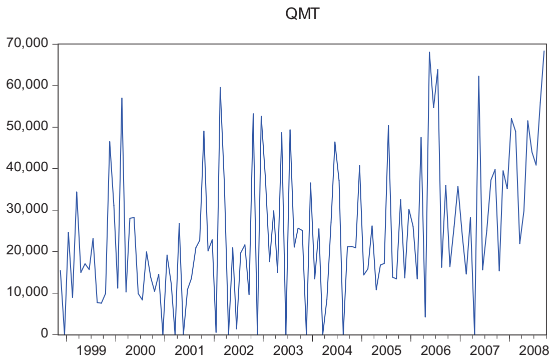

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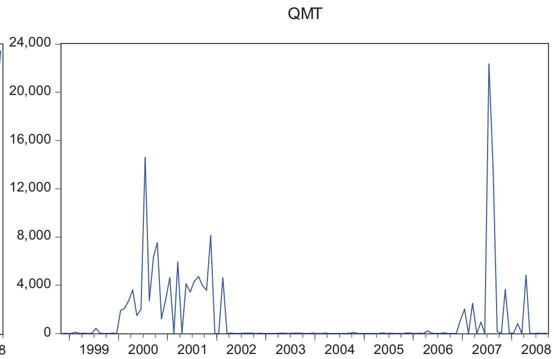

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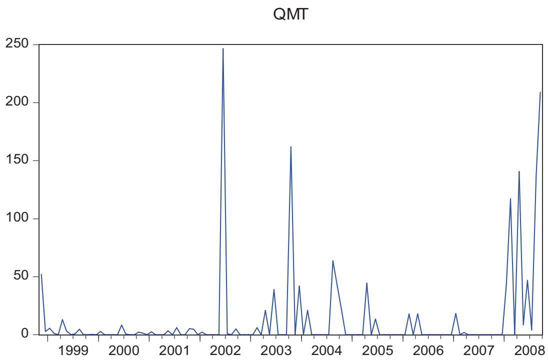

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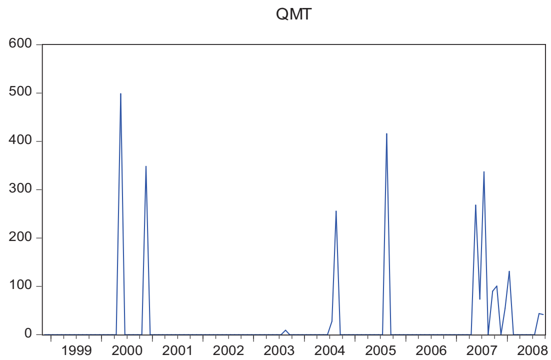

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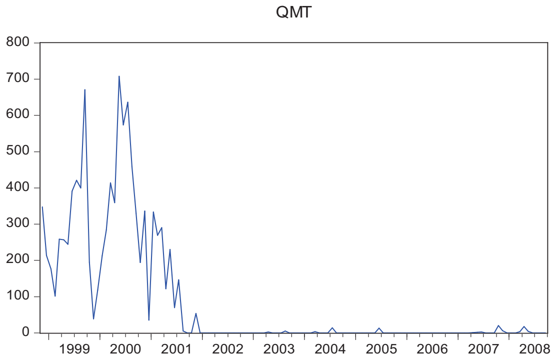
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3 Model Specification

Section 3 contains the ADF test results for OIL, RGDP and EXRA (3.1) and the specification estimates for the steel exporting countries (3.2) and for steel exports per export category (3.3). Moreover section 3 contains the t-statistics/adjustment vectors of the VECMs for the steel exporting countries (3.4) and the steel exports per category (3.5).

3.1 ADF-Test Results – OIL, RGDP, EXRA

Section 3.1 shows the ADF test results for the oil price, real GDP and exchange rate variables.

Table A3.1 ADF Test Results – OIL, RGDP

Information	ADF Test Results (p-values)	
Criteria	OIL	RGDP
SIC	0.848	0.404
AIC	0.848	0.404
HQC	0.848	0.404

Table A3.2 ADF Test Results –EXRA

European Union	Information Criteria	ADF Test (p-values)
Austria	SIC	0.812
	AIC	0.889
	HQC	0.889
Belgium	SIC	0.812
	AIC	0.889
	HQC	0.889
Bulgaria	SIC	0.129
	AIC	0.090
	HQC	0.140
Czech Republic	SIC	0.970
	AIC	0.970
	HQC	0.970
Denmark	SIC	0.816
	AIC	0.890
	HQC	0.890
Estonia	SIC	0.900
	AIC	0.900
	HQC	0.900
Finland	SIC	0.812
	AIC	0.889
	HQC	0.889
France	SIC	0.812
	AIC	0.889
	HQC	0.889
Germany	SIC	0.812
	AIC	0.889
	HQC	0.889
Hungary	SIC	0.931
	AIC	0.931
	HQC	0.931
Ireland	SIC	0.812
	AIC	0.889
	HQC	0.889

European Union	Information Criteria	ADF Test (p-values)
Italy	SIC	0.812
	AIC	0.889
	HQC	0.889
Latvia	SIC	0.751
	AIC	0.620
	HQC	0.751
Lithuania	SIC	0.833
	AIC	0.841
	HQC	0.793
Luxembourg	SIC	0.812
	AIC	0.889
	HQC	0.889
Netherlands	SIC	0.812
	AIC	0.889
	HQC	0.889
Poland	SIC	0.980
	AIC	0.980
	HQC	0.980
Portugal	SIC	0.812
	AIC	0.889
	HQC	0.889
Romania	SIC	0.042
	AIC	0.180*
	HQC	0.264*
Spain	SIC	0.812
	AIC	0.889
	HQC	0.889
Slovakia	SIC	0.977
	AIC	0.977
	HQC	0.977

*integrated of order 2, I(2)

European Union	Information Criteria	ADF Test (p-values)
Sweden	SIC	0.784
	AIC	0.857
	HQC	0.784
United Kingdom	SIC	0.804
	AIC	0.691
	HQC	0.804

Other Europe	Information Criteria	ADF Test (p-values)
Norway	SIC	0.825
	AIC	0.894
	HQC	0.894
Switzerland	SIC	0.832
	AIC	0.874
	HQC	0.832

Africa	Information Criteria	ADF Test (p-values)
	SIC	0.338
Algeria	AIC	0.491
	HQC	0.491
	SIC	0.526
Egypt	AIC	0.526
	HQC	0.526
	SIC	0.387
South Africa	AIC	0.387
	HQC	0.387

Table A3.2 ADF Test Results –EXRA (continued)

North America	Information Criteria	ADF Test (p-values)
Canada	SIC	0.877
	AIC	0.932
	HQC	0.877
Costa Rica	SIC	0.880
	AIC	0.880
	HQC	0.880
Dominican Republic	SIC	0.366
	AIC	0.456
	HQC	0.366
El Salvador	SIC	0.618
	AIC	0.586
	HQC	0.618
Guatemala	SIC	0.003
	AIC	0.036
	HQC	0.036
Honduras	SIC	0.125
	AIC	0.125
	HQC	0.125
Mexico	SIC	0.645
	AIC	0.721
	HQC	0.645
Panama	SIC	0.471
	AIC	0.471
	HQC	0.471
Trinidad and Tobago	SIC	0.120
	AIC	0.120
	HQC	0.120

C.I.S.	Information Criteria	ADF Test (p-values)
Kazakhstan	SIC	0.002
	AIC	0.002
	HQC	0.002
Russia	SIC	0.366
	AIC	0.655
	HQC	0.366
Ukraine	SIC	0.009
	AIC	0.000
	HQC	0.009

*integrated of order 2, I(2)

South America	Information Criteria	ADF Test (p-values)
Argentina	SIC	0.393
	AIC	0.292
	HQC	0.393
Brazil	SIC	0.211
	AIC	0.493
	HQC	0.211
Chile	SIC	0.391
	AIC	0.391
	HQC	0.391
Colombia	SIC	0.155
	AIC	0.155
	HQC	0.155
Ecuador	SIC	0.000
	AIC	0.000
	HQC	0.000
Peru	SIC	0.625
	AIC	0.885
	HQC	0.885
Uruguay	SIC	0.505
	AIC	0.505
	HQC	0.505

Middle East	Information Criteria	ADF Test (p-values)
Israel	SIC	0.912
	AIC	0.608
	HQC	0.608
Saudi Arabia	SIC	0.000
	AIC	0.000
	HQC	0.000
Turkey	SIC	0.177
	AIC	0.175
	HQC	0.175
United Arab Emirates	SIC	0.001
	AIC	0.013
	HQC	0.001

Asia	Information Criteria	ADF Test (p-values)
China	SIC	0.912
	AIC	0.912
	HQC	0.912
Hong Kong	SIC	0.007
	AIC	0.027
	HQC	0.007
India	SIC	0.366
	AIC	0.366
	HQC	0.366
Indonesia	SIC	0.019
	AIC	0.019
	HQC	0.019
Japan	SIC	0.302
	AIC	0.302
	HQC	0.302
Malaysia	SIC	0.298
	AIC	0.154*
	HQC	0.154*
Philippines	SIC	0.332
	AIC	0.107
	HQC	0.332
Singapore	SIC	0.976
	AIC	0.941
	HQC	0.941
South Korea	SIC	0.599
	AIC	0.599
	HQC	0.599
Taiwan	SIC	0.134
	AIC	0.134
	HQC	0.134
Thailand	SIC	0.707
	AIC	0.707
	HQC	0.707

Oceania	Information Criteria	ADF Test (p-values)
Australia	SIC	0.902
	AIC	0.902
	HQC	0.902
New Zealand	SIC	0.853
	AIC	0.794
	HQC	0.794

3.2 Model Specification – Steel Exporting Countries

3.2.1 Stability Criteria Test Results for the VEC Models

Section 3.2 contains tables with model specification test results.The tables are structured as follows:

- The first column lists the steel exporting countries/steel product categories included in the analysis.
- The second column then lists the information criteria used for unit root testing and lag length selection, the Schwarz Information Criterion (SIC), the Akaike Information Criterion (AIC), and the Hannan-Quinn Criterion (HQC).
- The third column lists the unit root test results for the steel import variable (QMT) and the fourth column lists the unit root test results for the steel import value variable (VALUE).
- The fifth column lists the lag lengths suggested by the different information criteria.
- The sixth column lists the lag length selected.
- Column seven and eight list the number of cointegrating relationships estimated by using the trace test and maximum eigenvalue test.
- The ninth column shows whether autocorrelation has been detected. If no autocorrelation exists in the residuals, at least at the 5% level, this is indicated by a dash. If autocorrelation has been detected and could not be removed by adding additional lags, the test result indicating serial correlation and the lag length where serial correlation might exist are listed.

3.2.2 European Union

Stability Criteria VEC Model - EU

Country	Information Criteria	ADF Test Results (p-values) QMT	VALUE	Lag Length suggested	selected	Cointegration Relations Trace	Eigenvalue	selected	Auto-correlation
Austria	SIC	0.009	0.797	1					
	AIC	0.035	0.945	3, 10, 11, 15	10	2	0	2	-
	HQC	0.009	0.945	3					
Belgium	SIC	0.000	0.015	1, 3					
	AIC	0.138	0.180	3, 11, 12, 13, 14, 15	13	3	3	3	-
	HQC	0.000	0.072	3				(AIC)	
Bulgaria	SIC	0.020	0.062	1					
	AIC	0.020	0.062	3	10	4	1	1	-
	HQC	0.020	0.062	3					
Czech Republic	SIC	0.000	0.685	1					
	AIC	0.005	0.834	2, 3, 13, 15	2	2	2	2	-
	HQC	0.000	0.696	3					
Denmark	SIC	0.209	0.010	1					
	AIC	0.209	0.010	3	4	3	0	3	-
	HQC	0.209	0.010	3					
Estonia	SIC	0.000	0.000	1					
	AIC	0.001	0.012	3, 14, 15	15	2	1	2	-
	HQC	0.001	0.004	3					
Finland	SIC	0.047	0.027	1					
	AIC	0.655	0.027	3, 10, 11, 12, 14, 15	10	3	1	3	-
	HQC	0.047	0.027	3				(AIC)	
France	SIC	0.186	0.138	1					
	AIC	0.476	0.082*	3, 14, 15	8	3	0	3	-
	HQC	0.212	0.289	3					
Germany	SIC	0.000	0.408	1					
	AIC	0.000	0.408	3, 14, 15	5	2	2	2	-
	HQC	0.000	0.408	3					
Hungary	SIC	0.030	0.001	1					
	AIC	0.030	0.001	3, 15	8	1	1	1	-
	HQC	0.030	0.001	3					
Ireland	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3	3	1	1	1	-
	HQC	0.000	0.000	3					
Italy	SIC	0.003	0.550	1					
	AIC	0.032	0.729	10, 11, 12, 14, 5	11	3	3	3	-
	HQC	0.003	0.729	3					
Latvia	SIC	0.318	0.000	1, 2					
	AIC	0.318	0.233	4, 14, 15	9	2	1	2	-
	HQC	0.318	0.084	3					

Source: Author's calculations, EViews® *integrated of order 2, I(2)

Stability Criteria VEC Model - EU (continued)									
		ADF Test Results (p-values)		Lag Length		Cointegration Relations			
Country	Information Criteria	QMT	VALUE	suggested	selected	Trace	Eigenvalue	selected	Auto-correlation
Lithuania	SIC	0.000	0.000	1, 3					
	AIC	0.000	0.000	8, 9, 12, 13, 14, 15	9	1	0	1	-
	HQC	0.000	0.000	3, 14					
Luxembourg	SIC	0.000	0.917	1					
	AIC	0.000	0.995	9, 10, 11, 12, 14, 15	10	2	1	2	-
	HQC	0.000	0.995	3					
Netherlands	SIC	0.000	0.002	1					
	AIC	0.001	0.002	3, 14, 15	14	3	1	1	-
	HQC	0.001	0.002	3					
Poland	SIC	0.005	0.000	1					
	AIC	0.005	0.000	3, 10, 11, 15	11	2	2	2	-
	HQC	0.005	0.000	3					
Portugal	SIC	0.177	0.001	1					
	AIC	0.177	0.016	9, 10, 11, 12, 13, 14, 15	10	3	0	3	-
	HQC	0.177	0.001	3					
Romania	SIC	0.000	0.000	1					
	AIC	0.008	0.002	4, 15	15	1	0	1	0.0066 (lag 12)
	HQC	0.008	0.002	3					
Slovakia	SIC	0.977	0.002	1					
	AIC	0.977	0.002	3, 14, 15	14	2	1	2	-
	HQC	0.977	0.002	3					
Spain	SIC	0.000	0.000	1					
	AIC	0.585	0.143	3, 14, 15	4	2	2	2	-
	HQC	0.585	0.012	3					
Sweden	SIC	0.010	0.697	1					
	AIC	0.194	0.914	3, 11, 12, 13, 14, 15	12	2	2	2	-
	HQC	0.194	0.914	3					
United Kingdom	SIC	0.000	0.352	1					
	AIC	0.000	0.352	4, 12, 13, 14, 15	3	2	0	2	-
	HQC	0.000	0.352	3					

Source: Author's calculations, EViews®

3.2.3 Other Europe

Stability Criteria VEC Model - Other Europe									
		ADF Test Results (p-values)		Lag Length		Cointegration Relations			
Country	Information Criteria	QMT	VALUE	suggested	selected	Trace	Eigenvalue	selected	Auto-correlation
Norway	SIC	0.000	0.041	1					
	AIC	0.003	0.506	3, 14, 15	14	2	2	2	-
	HQC	0.000	0.451	3					
Switzerland	SIC	0.000	0.523	1					
	AIC	0.312	0.523	9, 11, 12, 13, 14, 15	3	2	1	2	-
	HQC	0.000	0.523	3				(AIC)	

Source: Author's calculations, EViews®

3.2.4 C.I.S.

Stability Criteria VEC Model - C.I.S.

Country	Information Criteria	ADF Test Results (p-values) QMT	VALUE	Lag Length suggested	selected	Cointegration Relations Trace	Eigenvalue	selected	Auto-correlation
Kazakhstan	SIC	0.007	0.000	2					
	AIC	0.007	0.000	3, 14, 15	15	1	0	1	0.0266 (lag 15)
	HQC	0.007	0.000	3					
Russia	SIC	0.000	0.000	1					
	AIC	0.000	0.015	3, 4, 14, 15	8	1	0	1	-
	HQC	0.000	0.015	3					
Ukraine	SIC	0.015	0.599	1, 2					
	AIC	0.015	0.950	5, 11, 12, 13, 14, 15	13	1	1	1	-
	HQC	0.015	0.599	3					

Source: Author's calculations, EViews®

3.2.5 North America

Stability Criteria VEC Model - North America

Country	Information Criteria	ADF Test Results (p-values) QMT	VALUE	Lag Length suggested	selected	Cointegration Relations Trace	Eigenvalue	selected	Auto-correlation
Canada	SIC	0.067	0.917	1					
	AIC	0.875	1.000	4, 12, 13, 14, 15	15	4	4	4	-
	HQC	0.067	1.000	3					
Costa Rica	SIC	0.000	0.000	1					
	AIC	0.014	0.000	10, 11, 12, 13, 14, 15	12	2	1	2	0.0458 (lag 1)
	HQC	0.000	0.000	3					
Dominican Republic	SIC	0.033	0.187	1					
	AIC	0.033	0.661	4, 13, 14, 15	15	2	2	2	0.0266 (lag 5) 0.0459 (lag 6)
	HQC	0.033	0.187	3					
El Salvador	SIC	0.002	0.002	1					
	AIC	0.110	0.098	10, 11, 12, 13, 14, 15	11	3	3	3	-
	HQC	0.002	0.098	3				(AIC)	
Guatemala	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 15	3	1	1	1	-
	HQC	0.000	0.000	3					
Honduras	SIC	0.030	0.016	1					
	AIC	0.030	0.016	3, 15	10	3	1	1	0.0495 (lag 4) 0.0205 (lag 6)
	HQC	0.030	0.016	3					
Mexico	SIC	0.000	0.833	1					
	AIC	0.000	0.796	4, 10, 11, 12, 13, 14, 15	10	1	1	1	-
	HQC	0.000	0.645	3					
Panama	SIC	0.000	0.891	1, 13					
	AIC	0.000	0.891	8, 11, 12, 13, 14, 15	13	4	2	2	-
	HQC	0.000	0.891	8, 13, 15					
Trinidad and Tobago	SIC	0.074	0.000	1					
	AIC	0.542	0.010	3, 13, 14, 15	13	4	2	2	-
	HQC	0.074	0.000	3					

Source: Author's calculations, EViews®

3.2.6 South America

Stability Criteria VEC Model - South America										
		ADF Test Results (p-values)								
	Information			Lag Length		Cointegration Relations			Auto-
Country	Criteria	QMT	VALUE	suggested	selected	Trace	Eigenvalue	selected	correlation
Argentina	SIC	0.046	0.000	2					
	AIC	0.276	0.002	3, 14, 15	8	2	2	2	-
	HQC	0.046	0.000	3				(AIC)	
Brazil	SIC	0.000	0.105	1					
	AIC	0.012	0.340	3, 10, 13, 14, 15	10	1	1	1	0.0480 (lag 1)
	HQC	0.012	0.105	3					
Chile	SIC	0.000	0.000	1					
	AIC	0.000	0.010	7, 9, 13, 14, 15	9	2	2	2	-
	HQC	0.000	0.000	3					
Colombia	SIC	0.000	0.981	2					
	AIC	0.000	0.981	3, 14, 15	9	2	2	2	-
	HQC	0.000	0.981	3					
Ecuador	SIC	0.000	0.000	1, 2					
	AIC	0.000	0.000	3, 4, 14	3	1	1	1	0.0471 (lag 1)
	HQC	0.000	0.000	3					
Peru	SIC	0.000	0.000	1					
	AIC	0.000	0.534	3, 12, 15	3	2	2	2	-
	HQC	0.000	0.000	3				(AIC)	
Uruguay	SIC	0.012	0.038	1					
	AIC	0.267	0.524	4, 12, 13, 14, 15	3	1	1	1	-
	HQC	0.012	0.038	3					

Source: Author's calculations, EViews®

3.2.7 Africa

Stability Criteria VEC Model - Africa									
		ADF Test Results (p-values)							
	Information			Lag Length		Cointegration Relations			Auto-
Country	Criteria	QMT	VALUE	suggested	selected	Trace	Eigenvalue	selected	correlation
	SIC	0.000	0.000	1					
Algeria	AIC	0.000	0.000	3, 14, 15	14	1	1	1	-
	HQC	0.000	0.000	3, 14					
	SIC	0.008	0.036	1					
Egypt	AIC	0.004	0.375	3, 13, 14, 15	15	2	2	2	-
	HQC	0.008	0.036	3				(AIC)	
	SIC	0.000	0.001	1					
South Africa	AIC	0.120	0.001	3, 15	8	1	1	1	-
	HQC	0.120	0.001	3				(AIC)	

Source: Author's calculations, EViews®

3.2.8 Middle East

Stability Criteria VEC Model - Middle East

Country	Information Criteria	ADF Test Results (p-values) QMT	VALUE	Lag Length suggested	selected	Cointegration Relations Trace	Eigenvalue	selected	Auto-correlation
Israel	SIC	0.000	0.000	1					
	AIC	0.000	0.000	4, 14, 15	3	1	0	1	-
	HQC	0.000	0.000	3					
Saudi Arabia	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 13, 14, 15	3	1	1	1	-
	HQC	0.000	0.000	3					
Turkey	SIC	0.075	0.080	1					
	AIC	0.075	0.068	4, 11, 12, 15	11	3	1	3	-
	HQC	0.075	0.080	3					
United Arab Emirates	SIC	0.000	1.000	1					
	AIC	0.408	0.918*	9, 12, 13, 14, 15	14	4	1	1	-
	HQC	0.408	1.000	4				(HQC)	

Source: Author's calculations, EViews® *integrated of order 2, I(2)

3.2.9 Asia

Stability Criteria VEC Model - Asia

Country	Information Criteria	ADF Test Results (p-values) QMT	VALUE	Lag Length suggested	selected	Cointegration Relations Trace	Eigenvalue	selected	Auto-correlation
China	SIC	0.729	0.998	2					
	AIC	0.729	0.155*	4, 11, 12, 13, 14, 15	4	1	2	2	-
	HQC	0.729	0.998	3					
Hong Kong	SIC	0.000	0.000	1					
	AIC	0.272	0.366	10, 11, 12, 13, 14, 15	3	3	3	3	-
	HQC	0.000	0.000	3, 15				(AIC)	
India	SIC	0.096	0.997	2					
	AIC	0.172	0.999	3, 13, 14, 15	14	3	3	3	-
	HQC	0.096	0.997	3					
Indonesia	SIC	0.147	0.000	1					
	AIC	0.176	0.426	3, 13, 14, 15	13	3	1	3	-
	HQC	0.176	0.000	3				(AIC)	
Japan	SIC	0.000	0.145	1					
	AIC	0.000	0.845	3, 14, 15	14	3	1	3	0.0045 (lag 6)
	HQC	0.000	0.145	3					
Malaysia	SIC	0.009	0.025	1					
	AIC	0.053	0.122	10, 11, 12, 13, 14, 15	12	1	1	1	0.0011 (lag 5) 0.0070 (lag 11)
	HQC	0.009	0.122	3, 14, 15					
Philippines	SIC	0.000	0.000	1					
	AIC	0.042	0.061	4, 15	3	3	1	3	-
	HQC	0.000	0.000	3					
Singapore	SIC	0.000	0.003	1					
	AIC	0.001	0.003	3, 15	3	1	1	1	-
	HQC	0.000	0.003	3					
South Korea	SIC	0.019	0.940	2					
	AIC	0.019	0.978	3, 4, 14, 15	6	1	0	1	-
	HQC	0.019	0.940	3					
Taiwan	SIC	0.053	0.345	1					
	AIC	0.101	0.345	4, 11, 12, 13, 14, 15	12	3	3	3	-
	HQC	0.101	0.345	3					
Thailand	SIC	0.009	0.215	1					
	AIC	0.009	0.215	3, 14, 15	3	2	2	2	-
	HQC	0.009	0.215	3					

Source: Author's calculations, EViews® *integrated of order 2, I(2)

3.2.10 Oceania

Stability Criteria VEC Model - Oceania

Country	Information Criteria	ADF Test Results (p-values) QMT	VALUE	Lag Length suggested	selected	Cointegration Relations Trace	Eigenvalue	selected	Auto-correlation
Australia	SIC	0.004	0.846	1					
	AIC	0.039	0.965	3, 10, 11, 15	10	2	0	2	0.0454 (lag 5)
	HQC	0.039	0.846	3					
New Zealand	SIC	0.000	0.045	1					
	AIC	0.001	0.129	3	5	3	0	3	-
	HQC	0.001	0.045	3				(AIC)	

Source: Author's calculations, EViews®

3.3 Model Specification – Steel Export Categories

3.3.1 European Union

3.3.1.1 Belgium

Stability Criteria VEC Model - Categories / Belgium

Product Category	Information Criteria	ADF Test Results (p-values) QMT	VALUE	Lag Length suggested	selected	Cointegration Relations Trace	Eigenvalue	selected	Auto-correlation
1A	SIC	0.006	0.170	1					
	AIC	0.136	0.127	5, 14, 15	2	2	0	2	-
	HQC	0.006	0.477	3				(AIC)	
1B	SIC	0.000	0.000	1					
	AIC	0.004	0.018	3, 14, 15	3	1	1	1	-
	HQC	0.000	0.000	3					
3	SIC	0.208	0.162	1					
	AIC	0.039	0.162	3, 15	15	4	4	4	-
	HQC	0.208	0.162	3					
4	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 15	5	2	2	2	-
	HQC	0.000	0.000	3					
6A	SIC	0.028	0.435	3					
	AIC	0.028	0.435	3, 11, 12, 13, 15	12	4	1	1	0.0021 (lag 8)
	HQC	0.028	0.435	3					
6B	SIC	0.003	0.016	1					
	AIC	0.003	0.016	10, 11, 12, 13, 14, 15	4	2	2	2	-
	HQC	0.003	0.016	3					
7	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 14, 15	14	3	1	1	-
	HQC	0.000	0.000	1, 3					
8	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 15	3	1	1	1	-
	HQC	0.000	0.000	3					
14	SIC	0.000	0.000	1					
	AIC	0.001	0.000	3, 14, 15	5	2	2	2	-
	HQC	0.001	0.000	3					
14A	SIC	0.000	0.000	1					
	AIC	0.000	0.331	10, 11, 13, 14, 15	10	2	1	2	-
	HQC	0.000	0.331	3, 15					
15	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3	3	1	1	1	-
	HQC	0.000	0.000	3					

Source: Author's calculations, EViews®

Stability Criteria VEC Model - Categories / Belgium (continued)										
		ADF Test Results (p-values)		Lag Length		Cointegration Relations				
Product Category	Information Criteria	QMT	VALUE	suggested	selected	Trace	Eigenvalue	selected		Auto-correlation
16	SIC	0.016	0.030	1						
	AIC	0.104	0.030	3	5	2	2	2		-
	HQC	0.104	0.030	3						
17	SIC	0.000	0.000	1						
	AIC	0.000	0.000	3, 13, 15	5	2	2	2		-
	HQC	0.000	0.000	3						
18	SIC	0.000	0.000	1						
	AIC	0.000	0.000	3, 12, 13, 14, 15	14	3	1	1		-
	HQC	0.000	0.000	3						
19	SIC	0.000	0.000	1						
	AIC	0.000	0.000	3, 15	3	1	1	1		-
	HQC	0.000	0.000	3						
20	SIC	0.000	0.000	1						
	AIC	0.000	0.127	3, 15	4	4	1	1		-
	HQC	0.000	0.000	3				(AIC)		
21A	SIC	0.000	0.000	1						
	AIC	0.000	0.000	3, 13, 14, 15	3	1	1	1		-
	HQC	0.000	0.000	3						
21B	SIC	0.000	0.000	1						
	AIC	0.000	0.000	3, 15	3	1	1	1		-
	HQC	0.000	0.000	3						
21CD	SIC	0.000	0.000	1						
	AIC	0.000	0.000	3, 15	5	2	2	2		-
	HQC	0.000	0.000	3						
21E	SIC	0.000	0.000	1						
	AIC	0.000	0.000	3, 15	4	2	2	2		-
	HQC	0.000	0.000	3						
23	SIC	0.775	0.031	1						
	AIC	0.431	0.031	5, 12, 13, 14, 15	13	2	2	2		-
	HQC	0.431	0.031	3						
28	SIC	0.050	0.046	1						
	AIC	0.008	0.017	10, 13, 14, 15	4	2	2	2		-
	HQC	0.013	0.017	3						
29	SIC	0.001	0.001	1						
	AIC	0.011	0.001	3, 11, 12, 15	5	2	2	2		-
	HQC	0.001	0.001	3						
29A	SIC	0.000	0.000	1						
	AIC	0.000	0.000	3, 15	11	1	1	1		-
	HQC	0.000	0.000	3						
31	SIC	0.000	0.000	1						
	AIC	0.001	0.000	3, 15	4	2	2	2		-
	HQC	0.000	0.000	3						
32	SIC	0.000	0.000	1						
	AIC	0.234	0.152	3, 13, 14, 15	3	2	2	2		-
	HQC	0.234	0.000	3				(HQC)		
33A	SIC	0.000	0.000	1						
	AIC	0.000	0.007	3, 14, 15	4	2	2	2		-
	HQC	0.000	0.000	3						
33B	SIC	0.000	0.000	1						
	AIC	0.000	0.130	3, 13, 14, 15	9	2	2	2		-
	HQC	0.000	0.130	3				(AIC)		

Source: Author's calculations, EViews®

Stability Criteria VEC Model - Categories / Belgium (continued)										
		ADF Test Results (p-values)		Lag Length		Cointegration Relations			
Product Category	Information Criteria	QMT	VALUE	suggested	selected	Trace	Eigenvalue	selected	Auto-correlation
34	SIC	0.000	0.000	1					
	AIC	0.024	0.066	3, 15	15	2	2	2	-
	HQC	0.000	0.001	3				(AIC)	
35	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3	5	2	2	2	-
	HQC	0.000	0.000	3					
36	SIC	0.000	0.000	1					
	AIC	0.009	0.000	10, 11, 13, 14, 15	13	1	1	1	0.0092 (lag 2)
	HQC	0.009	0.000	3					
37	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 14, 15	15	2	0	2	-
	HQC	0.000	0.000	3					

Source: Author's calculations, EViews®

3.3.1.2 France

Stability Criteria VEC Model - Categories / France									
		ADF Test Results (p-values)		Lag Length		Cointegration Relations			
Product Category	Information Criteria	QMT	VALUE	suggested	selected	Trace	Eigenvalue	selected	Auto-correlation
1B	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 15	15	2	0	2	0.0453 (lag 8)
	HQC	0.000	0.000	3					
3	SIC	0.000	0.004	1					
	AIC	0.000	0.053	3, 12, 15	12	1	0	1	-
	HQC	0.000	0.053	3					
4	SIC	0.000	0.000	1					
	AIC	0.002	0.000	5, 14, 15	5	2	2	2	-
	HQC	0.002	0.000	3					
6A	SIC	0.000	0.096	1					
	AIC	0.000	0.640	9, 12, 13, 14, 15	2	2	2	2	-
	HQC	0.000	0.096	3					
6B	SIC	0.000	0.000	1					
	AIC	0.001	0.101	3, 14, 15	3	1	1	1	-
	HQC	0.001	0.000	3					
7	SIC	0.125	0.027	1					
	AIC	0.228	0.071	3, 9, 11, 15	9	4	3	4	-
	HQC	0.125	0.027	3				(AIC)	
14	SIC	0.034	0.000	1					
	AIC	0.034	0.000	3, 15	4	2	2	2	-
	HQC	0.034	0.000	3					

Source: Author's calculations, EViews®

Stability Criteria VEC Model - Categories / France (continued)									
		ADF Test Results (p-values)		Lag Length		Cointegration Relations			
Product Category	Information Criteria	QMT	VALUE	suggested	selected	Trace	Eigenvalue	selected	Auto-correlation
14A	SIC	0.000	0.000	1					
	AIC	0.122	0.343	3, 13, 14, 15	4	2	2	2	-
	HQC	0.122	0.058	3					
16	SIC	0.000	0.217	1					
	AIC	0.070	0.217	3, 14, 15	3	1	1	1	-
	HQC	0.000	0.217	3					
17	SIC	0.000	0.042	1					
	AIC	0.000	0.042	3, 13, 14, 15	13	1	1	1	-
	HQC	0.000	0.042	3					
18	SIC	0.178	0.001	1					
	AIC	0.081	0.104	3, 11, 12, 13, 14, 15	5	3	0	3	-
	HQC	0.081	0.104	3					
19	SIC	0.000	0.000	1					
	AIC	0.000	0.007	3, 14, 15	8	1	1	1	-
	HQC	0.000	0.000	3					
20	SIC	0.000	0.024	1					
	AIC	0.056	0.024	3, 4, 5, 7, 14, 15	7	3	1	3	-
	HQC	0.000	0.024	3				(AIC)	
21A	SIC	0.001	0.201	2, 3					
	AIC	0.081	0.201	5, 11, 12, 15	12	2	1	2	-
	HQC	0.001	0.201	3					
21B	SIC	0.000	0.005	1					
	AIC	0.000	0.730	4, 12, 13, 14, 15	7	1	1	1	-
	HQC	0.000	0.730	3					
21CD	SIC	0.000	0.397	1					
	AIC	0.000	0.799	4, 11, 13, 14, 15	14	4	2	2	-
	HQC	0.000	0.397	3					
21E	SIC	0.000	0.000	1, 3					
	AIC	0.000	0.000	3, 13, 14, 15	13	1	1	1	-
	HQC	0.000	0.000	3					
22A	SIC	0.000	0.000	1					
	AIC	0.003	0.000	3, 12, 14, 15	3	1	1	1	-
	HQC	0.003	0.000	3					
23	SIC	0.214	0.171	1					
	AIC	0.214	0.171	3, 13, 14, 15	13	5	3	3	-
	HQC	0.214	0.171	3					
28	SIC	0.481	0.222	2, 3					
	AIC	0.481	0.455	3, 5, 12, 14, 15	8	3	0	3	-
	HQC	0.481	0.455	3					
29	SIC	0.528	0.600	1					
	AIC	0.528	0.600	3, 13, 14, 15	4	2	0	2	-
	HQC	0.528	0.600	3					
29A	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 13, 14, 15	4	2	2	2	-
	HQC	0.000	0.000	3					
31	SIC	0.000	0.000	1					
	AIC	0.930	0.003	3, 14, 15	3	2	0	2	-
	HQC	0.012	0.003	3				(AIC)	
32	SIC	0.095	0.081	1					
	AIC	0.632	0.081	3, 13, 14, 15	7	3	1	3	-
	HQC	0.095	0.081	3					

Source: Author's calculations, EViews®

Stability Criteria VEC Model - Categories / France (continued)

Product Category	Information Criteria	ADF Test Results (p-values) QMT	VALUE	Lag Length suggested	Lag Length selected	Cointegration Relations Trace	Eigenvalue	selected	Auto-correlation
33A	SIC	0.0559	0.3462	2					
	AIC	0.3565	0.8102	6, 15	5	2	1	2	-
	HQC	0.0559	0.8102	3					
34	SIC	0.0000	0.0000	1					
	AIC	0.0000	0.0000	3, 13, 14, 15	3	1	1	1	-
	HQC	0.0000	0.0000	3					
35	SIC	0.0001	0.0000	1					
	AIC	0.0001	0.0000	3, 14, 15	7	1	1	1	-
	HQC	0.0001	0.0000	3					
36	SIC	0.0000	0.0000	1					
	AIC	0.0000	0.0000	3, 15	3	1	1	1	-
	HQC	0.0000	0.0000	3					
37	SIC	0.0228	0.0044	1					
	AIC	0.0596	0.0470	3, 13, 14, 15	2	2	2	2	-
	HQC	0.0596	0.0470	3				(AIC)	

Source: Author's calculations, EViews®

3.3.1.3 Germany

Stability Criteria VEC Model - Categories / Germany

Product Category	Information Criteria	ADF Test Results (p-values) QMT	VALUE	Lag Length suggested	Lag Length selected	Cointegration Relations Trace	Eigenvalue	selected	Auto-correlation
1A	SIC	0.000	0.000	1					
	AIC	0.000	0.029	5, 14, 15	5	2	2	2	-
	HQC	0.000	0.029	3					
1B	SIC	0.000	0.000	1					
	AIC	0.005	0.000	3, 14, 15	5	2	2	2	-
	HQC	0.000	0.000	3					
3	SIC	0.000	0.003	2					
	AIC	0.019	0.124	3, 4, 14	2	2	2	2	-
	HQC	0.019	0.003	3				(AIC)	
4	SIC	0.021	0.000	1					
	AIC	0.021	0.001	4, 12, 13, 14, 15	4	2	2	2	-
	HQC	0.021	0.000	3					
5	SIC	0.000	0.000	1					
	AIC	0.065	0.000	3, 12, 14, 15	12	2	1	2	-
	HQC	0.000	0.000	3				(AIC)	
6A	SIC	0.000	0.578	1					
	AIC	0.000	0.578	3, 15	2	3	1	3	-
	HQC	0.000	0.578	3					
6B	SIC	0.000	0.000	1					
	AIC	0.193	0.000	10, 12, 14, 15	12	1	0	1	-
	HQC	0.003	0.000	3					
7	SIC	0.012	0.000	1, 2					
	AIC	0.259	0.000	3, 14, 15	15	2	2	2	-
	HQC	0.162	0.000	3				(AIC)	

Source: Author's calculations, EViews®

Stability Criteria VEC Model - Categories / Germany (continued)									
Product Category	Information Criteria	ADF Test Results (p-values)		Lag Length		Cointegration Relations			Auto-correlation
		QMT	VALUE	suggested	selected	Trace	Eigenvalue	selected	
8	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 15	7	1	1	1	0.0452 (lag 1)
	HQC	0.000	0.000	3					
9	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3	3	1	1	1	-
	HQC	0.000	0.000	3					
14	SIC	0.000	0.000	1					
	AIC	0.000	0.673	3, 11, 12, 13, 14, 15	11	1	1	1	-
	HQC	0.000	0.000	3					
14A	SIC	0.000	0.000	1					
	AIC	0.000	0.489	3, 15	5	2	2	2	-
	HQC	0.000	0.489	3					
15	SIC	0.000	0.000	1					
	AIC	0.000	0.323	3, 15	3	2	0	2	-
	HQC	0.000	0.000	3				(AIC)	
16	SIC	0.386	0.864	1					
	AIC	0.386	0.872	3, 13, 14, 15	13	3	3	3	-
	HQC	0.386	0.864	3					
17	SIC	0.004	0.844	1					
	AIC	0.509	0.873	3, 15	5	3	0	3	-
	HQC	0.004	0.844	3					
18	SIC	0.000	0.030	1					
	AIC	0.475	0.953	10, 11, 12, 14, 15	3	1	1	1	-
	HQC	0.000	0.953	3					
19	SIC	0.003	0.382	1					
	AIC	0.022	0.382	3, 13, 14, 15	14	3	1	1	-
	HQC	0.003	0.382	3					
20	SIC	0.006	0.279	1					
	AIC	0.025	0.279	5, 11, 12, 13, 14, 15	11	2	1	2	-
	HQC	0.006	0.279	3					
21A	SIC	0.000	0.886	1					
	AIC	0.041	0.797	3, 15	7	2	0	2	-
	HQC	0.004	0.886	3					
21B	SIC	0.000	0.791	1					
	AIC	0.224	0.791	3, 11, 12, 13, 14, 15	11	3	2	3	-
	HQC	0.000	0.791	3				(AIC)	
21CD	SIC	0.000	0.345	1					
	AIC	0.079	0.858	3, 14, 15	3	1	1	1	-
	HQC	0.007	0.520	3					
21E	SIC	0.000	0.011	1					
	AIC	0.000	0.011	3, 14	4	2	2	2	-
	HQC	0.000	0.011	3					

Source: Author's calculations, EViews®

Stability Criteria VEC Model - Categories / Germany (continued)										
		ADF Test Results (p-values)		Lag Length		Cointegration Relations				
Product Category	Information Criteria	QMT	VALUE	suggested	selected	Trace	Eigenvalue	selected	Auto-correlation
22A	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 15	4	2	2	2	-
	HQC	0.000	0.000	3					
23	SIC	0.000	0.048	1					
	AIC	0.000	0.048	3, 15	15	2	0	2	-
	HQC	0.000	0.048	3					
28	SIC	0.000	0.000	1					
	AIC	0.074	0.179	3, 14, 15	3	1	1	1	-
	HQC	0.000	0.179	3					
29	SIC	0.013	0.015	2					
	AIC	0.033	0.068	10, 11, 12, 13, 14, 15	2	1	1	1	-
	HQC	0.033	0.015	3					
29A	SIC	0.000	0.000	1					
	AIC	0.003	0.029	3, 14, 15	7	1	1	1	-
	HQC	0.000	0.029	3					
31	SIC	0.001	0.125	1					
	AIC	0.001	0.021	3, 4, 12, 13, 14, 15	3	1	1	1	-
	HQC	0.001	0.125	3					
32	SIC	0.460	0.000	1					
	AIC	0.329	0.000	3, 14, 15	6	1	0	1	-
	HQC	0.460	0.000	3					
33A	SIC	0.031	0.019	1					
	AIC	0.075	0.033	7, 10, 13, 14, 15	3	2	0	2	-
	HQC	0.075	0.033	3				(AIC)	
33B	SIC	0.000	0.073	1					
	AIC	0.004	0.453	4, 5, 14, 15	4	3	0	3	-
	HQC	0.000	0.073	3					
34	SIC	0.000	0.905	1					
	AIC	0.012	0.801	3, 12, 13, 14, 15	3	2	1	2	-
	HQC	0.000	0.801	3					
35	SIC	0.000	0.078	1					
	AIC	0.000	0.528	4, 12, 13, 14, 15	13	2	2	2	-
	HQC	0.000	0.078	3					
36	SIC	0.000	0.000	1					
	AIC	0.684	0.000	8, 14, 15	8	2	1	2	-
	HQC	0.684	0.000	3				(AIC)	
37	SIC	0.600	0.651	1					
	AIC	0.600	0.780	8, 11, 12, 13, 14, 15	3	2	1	2	-
	HQC	0.600	0.780	3					

Source: Author's calculations, EViews®

3.3.1.4 Italy

Stability Criteria VEC Model - Categories / Italy

Product Category	Information Criteria	ADF Test Results (p-values) QMT	ADF Test Results (p-values) VALUE	Lag Length suggested	Lag Length selected	Cointegration Relations Trace	Cointegration Relations Eigenvalue	Cointegration Relations selected	Auto-correlation
1A	SIC	0.593	0.999	1					
	AIC	0.593	0.999	3, 12, 13, 14, 15	14	3	3	3	-
	HQC	0.593	0.999	3					
1B	SIC	0.001	0.005	1					
	AIC	0.069	0.177	3, 11, 12, 13, 14, 15	14	3	3	3	0.0432 (lag 3)
	HQC	0.014	0.000	3				(AIC)	
3	SIC	0.047	0.064	1					
	AIC	0.006	0.032	3	5	2	2	2	-
	HQC	0.047	0.064	3				(AIC)	
4	SIC	0.039	0.011	1					
	AIC	0.018	0.011	3, 11, 12, 13, 14, 15	13	1	1	1	0.0456 (lag 8)
	HQC	0.018	0.011	3					
6A	SIC	0.000	0.002	1					
	AIC	0.081	0.002	10, 11, 12, 13, 14, 15	3	1	1	1	-
	HQC	0.107	0.002	3					
6B	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 12, 13, 14, 15	12	1	0	1	-
	HQC	0.000	0.000	3					
7	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3	3	1	1	1	-
	HQC	0.000	0.000	3					
14	SIC	0.008	0.001	1					
	AIC	0.008	0.336	3, 15	4	2	2	2	-
	HQC	0.008	0.336	3					
14A	SIC	0.000	0.000	1					
	AIC	0.000	0.000	6, 13	5	2	2	2	-
	HQC	0.000	0.000	3					
15	SIC	0.045	0.027	1					
	AIC	0.065	0.068	3, 13, 15	13	1	1	1	-
	HQC	0.011	0.068	3					
16	SIC	0.059	0.772	1					
	AIC	0.116	0.895	4, 10, 11, 12, 13, 14, 15	10	2	2	2	-
	HQC	0.059	0.772	3					
17	SIC	0.000	0.000	1					
	AIC	0.424	0.334	9, 11, 12, 13, 14, 15	11	1	1	1	-
	HQC	0.424	0.334	3					
18	SIC	0.015	0.394	1					
	AIC	0.015	0.982	3, 12, 14, 15	15	3	1	3	-
	HQC	0.015	0.394	3					
19	SIC	0.000	0.000	1					
	AIC	0.000	0.000	6, 11, 13, 14, 15	11	1	1	1	-
	HQC	0.000	0.000	3					
20	SIC	0.377	0.707	1					
	AIC	0.377	0.910	10, 11, 12, 13, 14, 15	11	3	3	3	-
	HQC	0.377	0.977	3					
21A	SIC	0.043	0.944	1					
	AIC	0.043	0.999	5, 12, 13, 14, 15	12	2	1	2	-
	HQC	0.043	0.999	3					
21B	SIC	0.039	0.596	1					
	AIC	0.039	0.920	10, 11, 12, 13, 14, 15	3	1	0	1	-
	HQC	0.039	0.596	3					

Source: Author's calculations, EViews®

Stability Criteria VEC Model - Categories / Italy (continued)									
		ADF Test Results (p-values)		Lag Length		Cointegration Relations			
Product Category	Information Criteria	QMT	VALUE	suggested	selected	Trace	Eigenvalue	selected	Auto-correlation
21CD	SIC	0.000	0.000	1					
	AIC	0.000	0.463	3, 13, 15	13	1	1	2	-
	HQC	0.000	0.463	3					
21E	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 15	7	1	1	2	-
	HQC	0.000	0.000	3					
22A	SIC	0.000	0.000	1					
	AIC	0.000	0.327	3, 12, 14, 15	12	1	0	1	-
	HQC	0.000	0.327	3					
23	SIC	0.598	0.716	1					
	AIC	0.722	0.716	3, 12, 13, 14, 15	5	2	2	2	-
	HQC	0.426	0.716	3					
31	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 10, 11, 14, 15	10	2	1	2	-
	HQC	0.000	0.000	3					
32	SIC	0.000	0.000	1					
	AIC	0.000	0.045	3, 12, 13, 14, 15	3	1	1	1	-
	HQC	0.000	0.001	3					
33A	SIC	0.366	0.258	1					
	AIC	0.747	0.713	3, 15	3	2	0	2	-
	HQC	0.366	0.258	3					
34	SIC	0.195	0.184	1					
	AIC	0.049	0.054	6, 11, 12, 15	11	3	1	3	-
	HQC	0.195	0.184	3				(AIC)	
35	SIC	0.385	0.001	3					
	AIC	0.141	0.559	3, 11, 12, 13, 14, 15	11	4	1	1	-
	HQC	0.385	0.293	3					
36	SIC	0.000	0.054	1, 3					
	AIC	0.040	0.092	3, 11, 12, 13, 14, 15	13	4	2	2	-
	HQC	0.000	0.054	3					
37	SIC	0.195	0.128	1, 2					
	AIC	0.000	0.507	3, 13, 14, 15	3	2	1	2	-
	HQC	0.000	0.507	3					

Source: Author's calculations, EViews®

3.3.1.5 Netherlands

Stability Criteria VEC Model - Categories / Netherlands

Product Category	Information Criteria	ADF Test Results (p-values) QMT	VALUE	Lag Length suggested	selected	Cointegration Relations Trace	Eigenvalue	selected	Auto-correlation
1B	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 12, 13, 14, 15	5	2	2	2	-
	HQC	0.000	0.000	3					
3	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 14, 15	3	1	1	1	-
	HQC	0.000	0.000	3					
4	SIC	0.000	0.000	1					
	AIC	0.065	0.000	3, 10, 11, 14, 15	11	1	1	1	-
	HQC	0.000	0.000	3					
6A	SIC	0.000	0.000	1					
	AIC	0.003	0.000	10, 11, 12, 14, 15	14	3	1	1	-
	HQC	0.003	0.000	5					
6B	SIC	0.000	0.005	1					
	AIC	0.041	0.041	3, 14, 15	14	3	1	1	-
	HQC	0.041	0.005	3					
14	SIC	0.000	0.000	1					
	AIC	0.061	0.000	3, 13, 14, 15	5	2	2	2	-
	HQC	0.000	0.000	3					
14A	SIC	0.082	0.083	1, 3					
	AIC	0.082	0.083	8, 11, 12, 13, 14, 15	12	4	2	4	-
	HQC	0.082	0.083	4, 7, 8					
16	SIC	0.000	0.442	1					
	AIC	0.000	0.442	4, 13, 14, 15	4	3	1	3	-
	HQC	0.000	0.442	3					
17	SIC	0.000	0.000	1					
	AIC	0.022	0.248	3, 6, 13, 14, 15	6	2	2	2	-
	HQC	0.022	0.051	3				(AIC)	
18	SIC	0.000	0.030	1					
	AIC	0.394	0.086	5, 15	5	2	2	2	-
	HQC	0.074	0.030	4					
19	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 11, 12, 13, 14, 15	4	2	2	2	-
	HQC	0.000	0.000	3					
20	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 15	2	1	1	1	-
	HQC	0.000	0.000	3					
21A	SIC	0.000	0.000	1					
	AIC	0.000	0.000	5, 12, 13, 14, 15	4	2	2	2	0.0444 (lag 4)
	HQC	0.000	0.000	3					
21B	SIC	0.000	0.000	1					
	AIC	0.000	0.000	5, 11, 12, 13, 14, 15	5	2	2	2	-
	HQC	0.000	0.000	3					
21CD	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3	3	1	1	1	-
	HQC	0.000	0.000	3					
21E	SIC	0.000	0.000	1, 2					
	AIC	0.000	0.314	6, 12, 13, 14, 15	14	3	1	1	-
	HQC	0.000	0.000	3					
22A	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 13, 14, 15	13	1	1	1	-
	HQC	0.000	0.000	3					

Source: Author's calculations, EViews®

Stability Criteria VEC Model - Categories / Netherlands (continued)									
Product Category	Information Criteria	ADF Test Results (p-values) QMT	VALUE	Lag Length suggested	selected	Cointegration Relations Trace	Eigenvalue	selected	Auto-correlation
23	SIC	0.000	0.000	1					
	AIC	0.048	0.000	3	3	1	1	1	-
	HQC	0.000	0.000	3					
28	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3	3	1	1	1	-
	HQC	0.000	0.000	3					
29	SIC	0.000	0.444	1					
	AIC	0.686	0.742	3	3	2	2	2	-
	HQC	0.308	0.444	3				(AIC)	
29A	SIC	0.000	0.000	1					
	AIC	0.125	0.000	3, 14, 15	5	2	2	2	-
	HQC	0.000	0.000	3					
31	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 14, 15	3	1	1	1	-
	HQC	0.000	0.000	3					
32	SIC	0.009	0.003	1					
	AIC	0.087	0.003	3, 7, 8, 13, 14, 15	7	1	1	1	-
	HQC	0.087	0.003	3					
33A	SIC	0.000	0.001	1					
	AIC	0.000	0.001	3, 10, 13, 14, 15	4	2	2	2	-
	HQC	0.000	0.001	3					
34	SIC	0.000	0.000	1					
	AIC	0.000	0.001	3, 13, 14, 15	4	2	2	2	-
	HQC	0.000	0.000	3					
37	SIC	0.000	0.000	1					
	AIC	0.001	0.000	3, 10, 11, 12, 15	10	2	1	2	-
	HQC	0.001	0.000	3					

Source: Author's calculations, EViews®

3.3.1.6 Spain

Stability Criteria VEC Model - Categories / Spain

Product Category	Information Criteria	ADF Test Results (p-values) QMT	VALUE	Lag Length suggested	selected	Cointegration Relations Trace	Eigenvalue	selected	Auto-correlation
1B	SIC	0.126	0.041	1					
	AIC	0.126	0.230	3, 15	4	2	2	2	-
	HQC	0.126	0.230	3					
3	SIC	0.000	0.000	1					
	AIC	0.000	0.003	3	3	1	1	1	-
	HQC	0.000	0.000	3					
4	SIC	0.003	0.000	1					
	AIC	0.003	0.001	3, 13, 14, 15	4	2	2	2	-
	HQC	0.003	0.001	3					
6A	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 15	3	1	1	1	-
	HQC	0.000	0.000	3					
6B	SIC	0.163	0.016	1					
	AIC	0.163	0.033	10, 11, 12, 13, 14, 15	3	1	1	1	-
	HQC	0.163	0.016	3					
7	SIC	0.000	0.000	1					
	AIC	0.175	0.607	3, 12, 13, 14, 15	3	3	2	3	-
	HQC	0.175	0.002	3				(AIC)	
8	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 15	3	1	1	1	-
	HQC	0.000	0.000	3					
14	SIC	0.000	0.000	1					
	AIC	0.098	0.105	3, 14, 15	3	2	0	2	-
	HQC	0.000	0.105	3				(HQC)	
14A	SIC	0.002	0.218	3					
	AIC	0.000	0.234	8, 10, 11, 12, 13, 14, 15	10	2	1	2	-
	HQC	0.002	0.218	3					
16	SIC	0.008	0.001	1					
	AIC	0.065	0.166	3, 13, 14, 15	13	1	1	1	-
	HQC	0.065	0.012	3					
17	SIC	0.000	0.014	1					
	AIC	0.027	0.087	3, 14, 15	7	2	0	2	-
	HQC	0.027	0.087	3				(AIC)	
18	SIC	0.000	0.018	1					
	AIC	0.000	0.018	3, 13, 14, 15	3	1	1	1	-
	HQC	0.000	0.018	3					
19	SIC	0.000	0.596	1					
	AIC	0.000	0.952	3, 6, 13, 14, 15	5	3	3	3	-
	HQC	0.000	0.952	3					
20	SIC	0.146	0.236	3					
	AIC	0.036	0.236	6, 7, 10, 13, 14, 15	6	2	2	2	-
	HQC	0.146	0.236	3					
21A	SIC	0.000	0.139	1					
	AIC	0.000	0.139	3, 15	5	3	1	3	-
	HQC	0.000	0.139	3					
21B	SIC	0.000	0.000	1					
	AIC	0.561	0.394	5, 12, 13, 14, 15	5	3	3	3	-
	HQC	0.000	0.000	3				(AIC)	
21CD	SIC	0.000	0.063	1					
	AIC	0.000	0.995	3, 12, 13, 14, 15	12	2	0	2	0.0028 (lag 7)
	HQC	0.000	0.063	3					
21E	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 6, 14, 15	5	2	2	2	-
	HQC	0.000	0.000	3					

Source: Author's calculations, EViews®

Stability Criteria VEC Model - Categories / Spain (continued)										
Product Category	Information Criteria	ADF Test Results (p-values) QMT	VALUE	Lag Length suggested	selected	Cointegration Relations Trace	Eigenvalue	selected	Auto-correlation
22A	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 15	9	1	1	1	-
	HQC	0.000	0.000	3					
23	SIC	0.000	0.031	1					
	AIC	0.000	0.031	3, 10, 11, 12, 14	11	1	1	1	-
	HQC	0.000	0.031	3					
29	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 14, 15	4	2	2	2	-
	HQC	0.000	0.000	2, 3					
31	SIC	0.001	0.000	1					
	AIC	0.234	0.522	3, 12, 13, 14, 15	3	1	1	1	-
	HQC	0.234	0.000	3					
32	SIC	0.190	0.184	1					
	AIC	0.460	0.586	9, 12, 13, 14, 15	9	2	2	2	-
	HQC	0.460	0.184	3					
33A	SIC	0.322	0.275	1					
	AIC	0.651	0.615	3, 10, 11, 12, 14, 15	12	3	3	3	-
	HQC	0.651	0.615	3					
33B	SIC	0.000	0.000	1					
	AIC	0.173	0.000	3, 15	3	1	1	1	-
	HQC	0.000	0.000	3					
34	SIC	0.000	0.000	3					
	AIC	0.000	0.000	3, 10, 15	10	2	1	2	-
	HQC	0.000	0.000	3					
37	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 12, 13, 14, 15	3	1	1	1	-
	HQC	0.000	0.000	3					

Source: Author's calculations, EViews®

3.3.2 C.I.S.

3.3.2.1 Russia

Stability Criteria VEC Model - Categories / Russia

Product	Information	ADF Test Results (p-values)		Lag Length		Cointegration Relations			Auto-
Category	Criteria	QMT	VALUE	suggested	selected	Trace	Eigenvalue	selected	correlation
1B	SIC	0.000	0.000	1					
	AIC	0.002	0.001	3, 4	8	1	0	1	-
	HQC	0.000	0.001	3					
3	SIC	0.000	0.000	1					
	AIC	0.000	0.118	10, 11, 12, 13, 14	11	2	2	2	0.0421 (lag 2)
	HQC	0.000	0.000	3				(AIC)	
4	SIC	0.000	0.000	1					
	AIC	0.000	0.000	4, 9, 13, 14, 15	9	1	0	1	-
	HQC	0.000	0.000	3					
6A	SIC	0.000	0.102	2					
	AIC	0.010	0.760	3, 11, 12, 13, 14, 15	3	2	1	2	-
	HQC	0.000	0.102	3					
6B	SIC	0.163	0.016	1					
	AIC	0.163	0.033	10, 11, 12, 13, 14, 15	14	1	1	1	-
	HQC	0.163	0.016	3					
14	SIC	0.000	0.000	1, 2					
	AIC	0.001	0.000	3, 14, 15	7	2	2	2	-
	HQC	0.001	0.000	3					
15	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3	6	1	1	1	-
	HQC	0.000	0.000	2, 3					
16	SIC	0.000	0.000	1					
	AIC	0.000	0.573	8, 11, 15	15	2	2	2	-
	HQC	0.000	0.000	3				(AIC)	
17	SIC	0.000	0.006	1					
	AIC	0.000	0.357	10, 11, 12, 13, 15	12	1	1	1	-
	HQC	0.000	0.006	3					
18	SIC	0.283	0.348	1					
	AIC	0.283	0.907	10, 11, 12, 13, 14, 15	3	3	2	3	-
	HQC	0.283	0.348	3, 15					
19	SIC	0.027	0.036	1					
	AIC	0.538	0.261	10, 11, 12, 13, 14, 15	12	3	3	3	-
	HQC	0.027	0.261	3				(AIC)	
20	SIC	0.559	0.647	1					
	AIC	0.737	0.848	4, 11, 12, 13, 14, 15	4	1	1	1	-
	HQC	0.559	0.647	3					
21A	SIC	0.003	0.008	1					
	AIC	0.407	0.355	7, 8, 11, 12, 13, 14, 15	7	2	2	2	-
	HQC	0.134	0.008	3					
23	SIC	0.009	0.001	1					
	AIC	0.009	0.019	3, 14, 15	4	1	0	1	-
	HQC	0.009	0.019	3					
31	SIC	0.002	0.002	1					
	AIC	0.002	0.009	8, 12, 13, 14, 15	8	1	0	1	-
	HQC	0.002	0.001	3					
32	SIC	0.000	0.000	1					
	AIC	0.007	0.039	3, 8, 14, 15	8	1	0	1	-
	HQC	0.000	0.015	3					

Source: Author's calculations, EViews®

Stability Criteria VEC Model - Categories / Russia (continued)										
		ADF Test Results (p-values)		Lag Length		Cointegration Relations				
Product Category	Information Criteria	QMT	VALUE	suggested	selected	Trace	Eigenvalue	selected	Auto-correlation
33A	SIC	0.000	0.000	1					
	AIC	0.001	0.000	3, 8, 15	8	1	0	1	-
	HQC	0.000	0.000	3					
35	SIC	0.020	0.234	1					
	AIC	0.200	0.837	3, 11, 12, 13, 14, 15	3	2	1	2	-
	HQC	0.020	0.234	3					
37	SIC	0.000	0.000	2					
	AIC	0.000	0.000	4, 13, 14, 15	5	1	0	1	-
	HQC	0.000	0.000	3					

Source: Author's calculations, EViews®

3.3.2.2 Ukraine

Stability Criteria VEC Model - Categories / Ukraine									
		ADF Test Results (p-values)		Lag Length		Cointegration Relations			
Product Category	Information Criteria	QMT	VALUE	suggested	selected	Trace	Eigenvalue	selected	Auto-correlation
1B	SIC	0.0127	0.4424	1, 2, 3					
	AIC	0.2803	0.9130	5, 11, 13, 14, 15	10	1	1	1	-
	HQC	0.0127	0.4424	3					
3	SIC	0.3638	0.3858	1, 2, 3					
	AIC	0.7068	0.7015	10, 11, 12, 13, 14, 15	12	2	2	2	0.0140 (lag 4)
	HQC	0.6977	0.6950	3, 4, 15					
4	SIC	0.0000	0.0000	3, 4					
	AIC	0.0000	0.0000	7, 12, 13, 14, 15	15	1	0	1	0.0047 (lag 8) 0.0230 (lag 9)
	HQC	0.0000	0.0000	3, 4, 5					
6A	SIC	0.0000	0.0017	1					
	AIC	0.0000	0.0017	4, 5, 13, 14, 15	15	1	0	1	-
	HQC	0.0000	0.0017	3					
6B	SIC	0.0315	0.0099	2, 3					
	AIC	0.1654	0.1208	10, 11, 12, 13, 14, 15	3	1	1	1	0.0037 (lag 3)
	HQC	0.1654	0.0167	3, 10, 12, 14, 15					
14	SIC	0.0019	0.0043	3					
	AIC	0.1343	0.1059	5, 6, 13, 14, 15	11	1	1	1	-
	HQC	0.0183	0.0043	3				(AIC)	

Source: Author's calculations, EViews®

Stability Criteria VEC Model - Categories / Ukraine (continued)										
		ADF Test Results (p-values)		Lag Length		Cointegration Relations				
Product Category	Information Criteria	QMT	VALUE	suggested	selected	Trace	Eigenvalue	selected	Auto-correlation
16	SIC	0.158	0.339	1, 2, 3					
	AIC	0.281	0.339	5, 13, 14, 15	5	1	1	1	-
	HQC	0.158	0.339	3, 5					
17	SIC	0.000	0.000	1					
	AIC	0.000	0.000	4, 9, 12, 14, 15	3	1	1	1	-
	HQC	0.000	0.000	3					
18	SIC	0.001	0.006	1, 2, 3					
	AIC	0.016	0.268	4, 15	3	1	1	1	-
	HQC	0.016	0.006	3					
21A	SIC	0.000	0.000	1					
	AIC	0.036	0.153	4, 15	3	1	1	1	-
	HQC	0.000	0.153	3					
21B	SIC	0.000	0.000	1, 2					
	AIC	0.000	0.000	3, 4, 15	3	1	1	1	-
	HQC	0.000	0.000	3					
21CD	SIC	0.968	1.000	1					
	AIC	0.996	1.000	6, 13, 14, 15	14	1	1	1	0.0153 (lag 14)
	HQC	0.968	1.000	5, 6					
22A	SIC	0.000	0.066	1					
	AIC	0.000	0.999	3, 4, 5, 15	4	1	0	1	-
	HQC	0.000	1.000	3					
31	SIC	0.033	0.033	2					
	AIC	0.033	0.033	10 12, 13, 14, 15	3	1	1	1	0.0455 (lag 2) 0.0360 (lag 3)
	HQC	0.033	0.033	4					
32	SIC	0.000	0.000	1					
	AIC	0.000	0.000	4, 12, 13, 14, 15	15	1	0	1	-
	HQC	0.000	0.000	3					

Source: Author's calculations, EViews®

3.3.3 North America

3.3.3.1 Canada

Stability Criteria VEC Model - Categories / Canada

Product Category	Information Criteria	ADF Test Results (p-values) QMT	VALUE	Lag Length suggested	selected	Cointegration Relations Trace	Eigenvalue	selected	Auto-correlation
1A	SIC	0.362	0.342	1					
	AIC	0.292	0.342	3, 5, 15	6	3	3	3	-
	HQC	0.362	0.342	3					
1B	SIC	0.132	0.999	1					
	AIC	0.683	0.869*	3, 12, 13, 15	12	2	2	2	0.0435 (lag 9)
	HQC	0.683	0.999	3					
3	SIC	0.167	0.873	1					
	AIC	0.107*	0.873	4, 12, 13, 15	12	4	4	4	-
	HQC	0.167	0.873	3					
4	SIC	0.000	0.175	1					
	AIC	0.000	0.432	3	3	1	1	1	-
	HQC	0.002	0.432	3					
5	SIC	0.060	0.000	1					
	AIC	0.060	0.000	3, 15	5	2	1	2	-
	HQC	0.060	0.000	3					
6A	SIC	0.210	0.872	1					
	AIC	0.210	1.000	3, 13, 14, 15	4	3	0	3	-
	HQC	0.210	0.999	3					
6B	SIC	0.398	0.998	1					
	AIC	0.994	0.098*	3, 14, 15	6	2	2	2	-
	HQC	0.398	1.000	3					
7	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3	3	1	1	1	-
	HQC	0.000	0.000	3					
8	SIC	0.000	0.274	1					
	AIC	0.000	0.960	3, 11, 13, 14, 15	11	1	1	1	-
	HQC	0.000	0.947	3					
9	SIC	0.000	0.001	1					
	AIC	0.000	0.013	3, 15	3	1	1	1	-
	HQC	0.000	0.001	3					
14	SIC	0.331	0.103	1					
	AIC	0.889	0.620	3, 11, 12, 13, 14, 15	12	4	2	4	-
	HQC	0.331	0.103	3					
14A	SIC	0.000	0.404	1					
	AIC	0.002	0.404	3	14	2	0	2	-
	HQC	0.000	0.404	3, 13, 14, 15					
15	SIC	0.000	0.000	1					
	AIC	0.456	0.510	3, 13, 14, 15	3	2	1	2	-
	HQC	0.307	0.510	3				(AIC)	
16	SIC	0.868	0.228	1					
	AIC	0.868	0.228	3, 13, 14, 15	6	2	1	2	-
	HQC	0.868	0.228	3					
17	SIC	0.006	0.001	1					
	AIC	0.006	0.001	3, 14, 15	7	1	1	1	-
	HQC	0.006	0.001	3					

Source: Author's calculations, EViews® *integrated of order 2, I(2)

Stability Criteria VEC Model - Categories / Canada (continued)										
		ADF Test Results (p-values)		Lag Length		Cointegration Relations				
Product Category	Information Criteria	QMT	VALUE	suggested	selected	Trace	Eigenvalue	selected		Auto-correlation
18	SIC	0.043	0.987	1						
	AIC	0.132	0.547*	3, 13, 14, 15	14	4	2	2		-
	HQC	0.043	0.987	3						
19	SIC	0.393	0.682	1						
	AIC	0.999	1.000	3, 8, 13, 14, 15	8	3	1	3		-
	HQC	0.393	0.871	3						
20	SIC	0.002	0.051	1, 2						
	AIC	0.002	0.607	3, 11, 12, 14, 15	2	2	1	2		-
	HQC	0.002	0.051	3						
21A	SIC	0.023	0.067	1						
	AIC	0.052*	0.181*	3, 15	4	1	0	1		-
	HQC	0.052*	0.055*	3						
21B	SIC	0.287	0.000	1						
	AIC	0.287	0.586	3, 12, 13, 14, 15	12	2	2	2		-
	HQC	0.287	0.000	3				(AIC)		
21CD	SIC	0.360	0.992	1						
	AIC	0.535	0.978	3, 8, 12, 13, 14, 15,	8	3	0	3		0.0446 (lag 3)
	HQC	0.360	0.360	3						
21E	SIC	0.000	0.015	1						
	AIC	0.295	0.983	3, 11, 12, 15	11	3	2	3		-
	HQC	0.000	0.102	3				(AIC)		
22A	SIC	0.004	0.759	1						
	AIC	0.284	0.866	3, 10, 11, 12, 14, 15	10	3	2	3		-
	HQC	0.759	0.759	3				(AIC)		
22B	SIC	0.000	0.000	1						
	AIC	0.000	0.000	3, 8, 15	8	1	0	1		-
	HQC	0.000	0.000	3						
28	SIC	0.002	0.000	1						
	AIC	0.029	0.052	3	3	2	1	2		-
	HQC	0.029	0.052	3				(AIC)		
29	SIC	0.577	0.853	1						
	AIC	0.726	0.906	3, 14, 15	3	2	2	2		-
	HQC	0.726	0.853	3						
29A	SIC	0.000	0.000	1						
	AIC	0.505	0.881	3, 15	3	1	1	1		-
	HQC	0.000	0.881	3						
31	SIC	0.076	1.000	1, 2						
	AIC	0.834	1.000	3, 10, 11, 12, 13, 14, 15	2	2	1	2		-
	HQC	0.834	1.000	3						
32	SIC	0.005	0.028	1						
	AIC	0.005	0.126	10, 11, 12, 13, 14, 15	12	3	1	3		-
	HQC	0.005	0.028	3				(AIC)		
33A	SIC	0.000	0.297	1						
	AIC	0.001	0.769	3, 13, 14, 15	8	3	2	3		-
	HQC	0.001	0.297	3						
33B	SIC	0.098	0.233	1						
	AIC	0.098	0.811	3, 15	4	2	2	2		-
	HQC	0.098	0.233	3						

Source: Author's calculations, EViews®   *integrated of order 2, I(2)

Stability Criteria VEC Model - Categories / Canada (continued)									
		ADF Test Results (p-values)		Lag Length		Cointegration Relations			
Product Category	Information Criteria	QMT	VALUE	suggested	selected	Trace	Eigenvalue	selected	Auto-correlation
34	SIC	0.580	0.428	1					
	AIC	0.721	0.482	3, 14, 15	8	1	1	1	-
	HQC	0.580	0.428	3					
35	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 15	3	1	1	1	-
	HQC	0.000	0.000	3					
36	SIC	0.009	0.032	1					
	AIC	0.009	0.032	3, 12, 13, 14, 15	3	1	1	1	-
	HQC	0.009	0.032	3					
37	SIC	0.004	0.000	1					
	AIC	0.290	0.016	3, 14, 15	3	1	0	1	-
	HQC	0.360	0.016	3				(AIC)	

Source: Author's calculations, EViews®

3.3.3.2 Mexico

Stability Criteria VEC Model - Categories / Mexico									
		ADF Test Results (p-values)		Lag Length		Cointegration Relations			
Product Category	Information Criteria	QMT	VALUE	suggested	selected	Trace	Eigenvalue	selected	Auto-correlation
1A	SIC	0.000	0.000	1					
	AIC	0.082	0.074	3, 4, 10, 11, 14, 15	10	4	2	4	-
	HQC	0.082	0.074	3				(AIC)	
1B	SIC	0.000	0.674	1, 2					
	AIC	0.004	0.674	3, 4, 13, 14, 15	2	1	0	1	-
	HQC	0.013	0.674	3					
3	SIC	0.214	0.174	1					
	AIC	0.719	0.588	3, 4, 14, 15	15	4	4	4	0.0494 (lag 13)
	HQC	0.719	0.139	3					
4	SIC	0.700	1.000	1					
	AIC	0.993	1.000	10, 13, 14, 15	10	3	3	3	-
	HQC	0.993	1.000	3					
6A	SIC	0.000	0.000	1					
	AIC	0.000	0.000	4, 11, 12, 13, 14, 15	11	1	1	1	-
	HQC	0.000	0.000	3					
6B	SIC	0.004	0.143	1					
	AIC	0.010	0.066	4, 11, 12, 13, 14, 15	11	1	1	1	0.0492 (lag 8)
	HQC	0.038	0.066	3					
8	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 11, 12, 14, 15	11	1	1	1	-
	HQC	0.000	0.000	3					
9	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 4, 13, 14, 15	14	1	1	1	0.0325 (lag 8)
	HQC	0.000	0.000	3					

Source: Author's calculations, EViews®

Stability Criteria VEC Model - Categories / Mexico (continued)									
		ADF Test Results (p-values)		Lag Length		Cointegration Relations			
Product Category	Information Criteria	QMT	VALUE	suggested	selected	Trace	Eigenvalue	selected	Auto-correlation
14	SIC	0.103	0.573	1					
	AIC	0.387	0.614	3, 15	6	1	0	1	-
	HQC	0.103	0.573	2, 3					
14A	SIC	0.000	0.000	1					
	AIC	0.000	0.143	3, 13, 14, 15	13	2	2	2	-
	HQC	0.000	0.000	3				(AIC)	
15	SIC	0.009	0.551	1					
	AIC	0.063	0.787	4, 13, 14, 15	3	3	1	3	-
	HQC	0.009	0.551	3				(AIC)	
16	SIC	0.006	0.000	1					
	AIC	0.006	0.003	3, 13, 14, 15	13	1	1	1	-
	HQC	0.006	0.003	3					
17	SIC	0.000	0.820	1					
	AIC	0.000	0.820	4, 13, 14, 15	4	1	1	1	-
	HQC	0.000	0.820	3					
18	SIC	0.000	0.221	1					
	AIC	0.000	0.642	3, 14, 15	4	1	0	1	-
	HQC	0.000	0.642	3					
20	SIC	0.000	0.898	2					
	AIC	0.000	0.898	3, 13, 14, 15	13	1	1	1	-
	HQC	0.000	0.898	3					
21A	SIC	0.003	0.920	1					
	AIC	0.276	0.920	10, 12, 13, 14, 15	3	2	1	2	-
	HQC	0.003	0.920	3				(AIC)	
21B	SIC	0.006	0.000	1					
	AIC	0.170	0.000	9, 11, 12, 13, 14, 15	12	1	1	1	-
	HQC	0.006	0.000	3					
21CD	SIC	0.000	0.188	1					
	AIC	0.038	0.682	3, 4, 15	5	1	1	1	-
	HQC	0.000	0.188	3					
21E	SIC	0.007	0.001	1					
	AIC	0.007	0.001	3, 14, 15	2	1	1	1	-
	HQC	0.007	0.001	3					

Source: Author's calculations, EViews®

Stability Criteria VEC Model - Categories / Mexico (continued)										
Product Category	Information Criteria	ADF Test Results (p-values) QMT	VALUE	Lag Length suggested	selected	Cointegration Relations Trace	Eigenvalue	selected	Auto-correlation
22A	SIC	0.112	0.451	1					
	AIC	0.112	0.620	6, 11, 12, 13, 14, 15	3	2	0	2	-
	HQC	0.112	0.451	3					
22B	SIC	0.202	0.333	1					
	AIC	0.310	0.324	9, 11, 12, 13, 14, 15	5	1	1	1	-
	HQC	0.310	0.324	3					
23	SIC	0.600	0.887	1					
	AIC	0.600	0.887	10, 11, 12, 13, 14, 15	4	2	1	2	-
	HQC	0.600	0.887	3, 15					
28	SIC	0.353	0.291	1					
	AIC	0.001	0.291	4	3	1	1	1	-
	HQC	0.353	0.291	3				(AIC)	
29	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 9, 10, 11, 15	9	1	0	1	-
	HQC	0.000	0.000	1, 3					
31	SIC	0.004	0.015	1					
	AIC	0.000	0.002	3, 9, 10, 13, 14, 15	9	1	0	1	-
	HQC	0.000	0.015	3					
32	SIC	0.000	0.317	1					
	AIC	0.001	0.552	1, 12, 13, 14, 15	7	1	1	1	-
	HQC	0.000	0.317	1					
33A	SIC	0.159	0.013	1					
	AIC	0.525	0.086	3, 14, 15	3	1	1	1	-
	HQC	0.309	0.086	3					
33B	SIC	0.000	0.000	1					
	AIC	0.000	0.000	10, 11, 12, 13, 14, 15	12	1	1	1	-
	HQC	0.000	0.000	3					
34	SIC	0.033	0.596	1					
	AIC	0.353	0.684	4, 12, 13, 14, 15	3	1	0	1	-
	HQC	0.240	0.596	3				(AIC)	
35	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 12, 13, 14, 15	15	2	1	2	-
	HQC	0.000	0.000	3					
36	SIC	0.018	0.583	1					
	AIC	0.003	0.709	4, 13, 14, 15	4	1	0	1	-
	HQC	0.018	0.709	3					
37	SIC	0.000	0.883	1					
	AIC	0.000	0.999	3, 12, 13, 14, 15	12	2	2	2	-
	HQC	0.000	0.883	1, 3					

Source: Author's calculations, EViews®

3.3.4 South America (Brazil)

Stability Criteria VEC Model - Categories / Brazil

Product Category	Information Criteria	ADF Test Results (p-values) QMT	VALUE	Lag Length suggested	selected	Cointegration Relations Trace	Eigenvalue	selected	Auto-correlation
1A	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 14, 15	3	1	1	1	0.0326 (lag 6) 0.0000 (lag 14)
	HQC	0.000	0.000	3					
1B	SIC	0.036	0.000	1					
	AIC	0.036	0.014	3, 13, 14, 15	3	1	1	1	-
	HQC	0.036	0.000	3					
3	SIC	0.000	0.000	1					
	AIC	0.564	0.195	3, 15	15	3	1	1	-
	HQC	0.000	0.195	3					
4	SIC	0.008	0.000	1					
	AIC	0.204	0.250	3, 13, 14, 15	15	3	1	1	-
	HQC	0.204	0.250	3					
6A	SIC	0.000	0.009	1					
	AIC	0.000	0.111	3, 4, 14, 15	9	1	0	1	-
	HQC	0.000	0.111	3					
6B	SIC	0.006	0.004	1					
	AIC	0.528	0.004	3, 13, 14, 15	15	3	1	1	-
	HQC	0.528	0.004	3					
9	SIC	0.000	0.000	1					
	AIC	0.484	0.157	10, 11, 12, 13, 14, 15	10	2	0	2	-
	HQC	0.000	0.157	3				(HQC)	
14	SIC	0.000	0.922	1					
	AIC	0.000	1.000	3, 14, 15	15	2	2	2	-
	HQC	0.000	0.922	3					
14A	SIC	0.000	0.000	1					
	AIC	0.146	0.071*	3, 11, 12, 13, 14, 15	15	3	1	1	0.0192 (lag 6)
	HQC	0.000	0.099*	3					
15	SIC	0.000	0.009	1					
	AIC	0.000	0.009	3, 12, 13, 14, 15	3	1	1	1	-
	HQC	0.000	0.009	3					
16	SIC	0.000	0.000	1					
	AIC	0.001	0.000	4, 13, 14, 15	3	1	1	1	-
	HQC	0.000	0.000	3					
17	SIC	0.003	0.854	1					
	AIC	0.003	0.917	10, 12, 13, 14, 15	13	2	2	2	-
	HQC	0.003	0.854	3					
18	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 15	9	1	0	1	-
	HQC	0.000	0.000	3					
19	SIC	0.518	0.722	1, 2, 3					
	AIC	0.229	0.722	3, 13, 14, 15	8	2	2	2	-
	HQC	0.518	0.722	3					
20	SIC	0.017	0.084	1					
	AIC	0.031	0.084	8, 13, 14, 15	7	1	1	1	-
	HQC	0.017	0.084	3					
21A	SIC	0.002	0.003	1, 2					
	AIC	0.002	0.710	9, 11, 12, 13, 14, 15	9	1	0	1	-
	HQC	0.002	0.003	3					

Source: Author's calculations, EViews® *integrated of order 2, I(2)

Stability Criteria VEC Model - Categories / Brazil (continued)										
		ADF Test Results (p-values)		Lag Length		Cointegration Relations			
Product Category	Information Criteria	QMT	VALUE	suggested	selected	Trace	Eigenvalue	selected	Auto-correlation
21B	SIC	0.004	0.084	1					
	AIC	0.004	0.084	3, 8, 15	8	2	1	2	-
	HQC	0.004	0.084	3					
21CD	SIC	0.000	0.000	1					
	AIC	0.000	0.003	4, 12, 13, 14, 15	4	1	0	1	-
	HQC	0.000	0.003	3					
21E	SIC	0.001	0.002	2, 3					
	AIC	0.001	0.000	9, 13, 14, 15	3	1	1	1	-
	HQC	0.001	0.000	3					
22A	SIC	0.186	0.168	1					
	AIC	0.338	0.334	8, 12, 13, 14, 15	4	1	1	1	0.0476 (lag 2)
	HQC	0.186	0.046	3, 4					
23	SIC	0.000	0.003	1					
	AIC	0.005	0.003	3, 14	7	1	0	1	-
	HQC	0.000	0.003	3					
28	SIC	0.000	0.000	1					
	AIC	0.000	0.000	4, 14, 15	15	3	1	1	-
	HQC	0.000	0.000	3					
29	SIC	0.000	0.000	1					
	AIC	0.012	0.006	3, 6, 12, 13, 14, 15	12	3	1	1	-
	HQC	0.000	0.006	3					
29A	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 14, 15	3	1	1	1	-
	HQC	0.000	0.000	3					
31	SIC	0.004	0.007	1					
	AIC	0.149	0.010	3, 12, 14, 15	3	1	1	1	-
	HQC	0.149	0.007	3					
33A	SIC	0.024	0.043	1					
	AIC	0.024	0.138	3, 13, 14, 15	3	1	0	1	-
	HQC	0.024	0.043	3				(AIC)	
33B	SIC	0.000	0.000	1					
	AIC	0.134	0.000	3, 13, 15	2	1	1	1	-
	HQC	0.000	0.000	3					
34	SIC	0.239	0.242	1					
	AIC	0.291	0.288	6, 11, 12, 13, 14, 15	12	4	4	4	0.0295 (lag 3)
	HQC	0.239	0.242	3					
35	SIC	0.001	0.000	3					
	AIC	0.979	0.545	10, 12, 13, 14, 15	6	2	1	2	-
	HQC	0.979	0.545	3, 15				(AIC)	
36	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 15	15	3	1	1	-
	HQC	0.000	0.000	3, 15					
37	SIC	0.000	0.000	1					
	AIC	0.006	0.004	8, 15	3	1	1	1	-
	HQC	0.000	0.000	3					

Source: Author's calculations, EViews®

3.3.5 Africa (South Africa)

Stability Criteria VEC Model - Categories / South Africa

Product Category	Information Criteria	ADF Test Results (p-values) QMT	VALUE	Lag Length suggested	selected	Cointegration Relations Trace	Eigenvalue	selected	Auto-correlation
1B	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 15	4	1	0	1	-
	HQC	0.000	0.000	3					
3	SIC	0.022	0.044	1					
	AIC	0.114	0.148	3, 15	3	1	1	1	-
	HQC	0.114	0.044	3					
4	SIC	0.310	0.293	1					
	AIC	0.485	0.293	3, 11, 12, 13, 14, 15	13	3	3	3	0.0167 (lag 9)
	HQC	0.485	0.293	3					
6A	SIC	0.000	0.049	1					
	AIC	0.272	0.312	3, 13, 14, 15	3	2	0	2	-
	HQC	0.272	0.312	3				(AIC)	
6B	SIC	0.262	0.106	1					
	AIC	0.262	0.106	3, 15	6	2	2	2	-
	HQC	0.262	0.106	3					
14	SIC	0.000	0.001	1					
	AIC	0.000	0.012	3, 14, 15	3	1	1	1	-
	HQC	0.000	0.001	3					
16	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3	3	1	1	1	-
	HQC	0.000	0.000	3					
18	SIC	0.011	0.056	1					
	AIC	0.011	0.056	3, 14, 15	7	1	0	1	-
	HQC	0.011	0.056	3					
19	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 11, 12, 13, 14, 15	11	1	1	1	-
	HQC	0.000	0.000	3					
20	SIC	0.003	0.034	1					
	AIC	0.026	0.034	3, 15	3	1	1	1	-
	HQC	0.003	0.034	3					
21A	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 15	3	1	1	1	-
	HQC	0.000	0.000	3					
21CD	SIC	0.547	0.479	1					
	AIC	0.547	0.479	3, 14, 15	8	1	1	1	-
	HQC	0.547	0.479	3					
21E	SIC	0.343	0.173	1					
	AIC	0.343	0.674	10, 11, 12, 13, 14, 15	4	1	1	1	-
	HQC	0.343	0.359	3					
22A	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 14, 15	3	1	1	1	-
	HQC	0.000	0.000	3					
22B	SIC	0.000	0.000	1					
	AIC	0.000	0.001	3, 13, 14, 15	3	1	1	1	-
	HQC	0.000	0.000	3					

Source: Author's calculations, EViews®

Stability Criteria VEC Model - Categories / South Africa (continued)									
		ADF Test Results (p-values)		Lag Length		Cointegration Relations			
Product Category	Information Criteria	QMT	VALUE	suggested	selected	Trace	Eigenvalue	selected	Auto-correlation
23	SIC	0.002	0.002	1					
	AIC	0.753	0.002	3, 10, 11, 12, 15	12	1	1	1	-
	HQC	0.002	0.002	3					
31	SIC	0.013	0.000	1					
	AIC	0.207	0.000	3, 10, 11, 15	11	1	1	1	-
	HQC	0.207	0.000	3					
32	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 10, 11, 12, 15	12	1	1	1	-
	HQC	0.000	0.000	3					
33A	SIC	0.003	0.035	1					
	AIC	0.003	0.201	3, 15	3	1	1	1	-
	HQC	0.003	0.201	3					
37	SIC	0.098	0.000	1					
	AIC	0.098	0.029	3, 10, 11	11	2	2	2	-
	HQC	0.098	0.000	3					

Source: Author's calculations, EViews®

3.3.6 Middle East (Turkey)

Stability Criteria VEC Model - Categories / Turkey									
		ADF Test Results (p-values)		Lag Length		Cointegration Relations			
Product Category	Information Criteria	QMT	VALUE	suggested	selected	Trace	Eigenvalue	selected	Auto-correlation
1B	SIC	0	0.0131	1					
	AIC	0.009	0.0131	3, 13, 14, 15	14	1	1	1	-
	HQC	0.009	0.0131	3					
3	SIC	0.069	0.097	1					
	AIC	0.449	0.046	4	8	1	1	1	-
	HQC	0.069	0.097	3					
4	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3	4	1	0	1	-
	HQC	0.000	0.000	3					
6A	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 14, 15	8	1	0	1	-
	HQC	0.000	0.000	3					
6B	SIC	0.000	0.247	1					
	AIC	0.006	0.247	4, 15	4	1	1	1	-
	HQC	0.006	0.247	3					
14	SIC	0.000	0.093	1					
	AIC	0.039	0.093	4, 6, 13, 14, 15	3	2	1	2	-
	HQC	0.000	0.093	3					
14A	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 14	5	1	0	1	-
	HQC	0.000	0.000	3					

Source: Author's calculations, EViews®

Stability Criteria VEC Model - Categories / Turkey (continued)

Product Category	Information Criteria	ADF Test Results (p-values) QMT	VALUE	Lag Length suggested	Lag Length selected	Cointegration Relations Trace	Eigenvalue	selected	Auto-correlation
15	SIC	0.0024	0.0054	1					
	AIC	0.0024	0.0054	3, 15	15	3	1	1	-
	HQC	0.0024	0.0054	3					
16	SIC	0.0000	0.0000	1					
	AIC	0.0000	0.0000	6	9	1	1	1	-
	HQC	0.0000	0.0000	6					
17	SIC	0.0000	0.0000	1					
	AIC	0.0000	0.0000	4, 12, 13, 15	3	1	1	1	-
	HQC	0.0000	0.0000	3					
18	SIC	0.0130	0.0138	1					
	AIC	0.2281	0.0770	4, 14, 15	14	5	3	3	-
	HQC	0.2281	0.0138	3				(AIC)	
19	SIC	0.0156	0.0347	1					
	AIC	0.0808	0.0347	3, 13, 14, 15	13	1	1	1	-
	HQC	0.0156	0.0347	3				(AIC)	
21A	SIC	0.0684	0.1045	1					
	AIC	0.0684	0.2408	3, 4, 7, 8, 15	7	3	0	3	-
	HQC	0.0684	0.1045	3					
21B	SIC	0.0000	0.0001	1					
	AIC	0.0000	0.0001	4, 15	4	1	0	1	-
	HQC	0.0000	0.0001	3					
21CD	SIC	0.0001	0.0271	1					
	AIC	0.0049	0.0138	3, 14, 15	3	1	1	1	-
	HQC	0.0001	0.0271	3					
22A	SIC	0.0470	0.1050	2					
	AIC	0.3129	0.2220	3, 12, 13, 14, 15	7	1	1	1	-
	HQC	0.3519	0.2220	3					
23	SIC	0.0000	0.0003	1					
	AIC	0.0758	0.0922	3, 10, 11, 15	11	1	0	1	-
	HQC	0.0758	0.0922	3					
31	SIC	0.0003	0.0015	1					
	AIC	0.0003	0.0013	3	3	1	1	1	-
	HQC	0.0003	0.0015	3					
32	SIC	0.0003	0.0012	1					
	AIC	0.0017	0.0027	3, 4, 15	15	3	1	1	-
	HQC	0.0000	0.0222	3					
33A	SIC	0.0016	0.0014	1					
	AIC	0.0016	0.0014	3, 14, 15	9	1	1	1	-
	HQC	0.0016	0.0014	3					
36	SIC	0.0000	0.0000	1					
	AIC	0.0000	0.0000	3, 11, 12	11	1	0	1	-
	HQC	0.0000	0.0000	3					
37	SIC	0.0000	0.0000	1					
	AIC	0.0000	0.0039	5, 14, 15	3	1	1	1	-
	HQC	0.0000	0.0000	3					

Source: Author's calculations, EViews®

3.3.7 Asia

3.3.7.1 China

Stability Criteria VEC Model - Categories / China

Product Category	Information Criteria	ADF Test Results (p-values) QMT	VALUE	Lag Length suggested	selected	Cointegration Relations Trace	Eigenvalue	selected	Auto-correlation
1A	SIC	0.00	0.00	1					
	AIC	0.00	0.00	8, 11, 13, 14, 15	8	1	0	1	0.0289 (lag 5)
	HQC	0.00	0.00	3					
1B	SIC	0.00	0.00	1					
	AIC	0.00	0.00	3, 15	2	1	1	1	-
	HQC	0.00	0.00	3					
3	SIC	0.07	0.00	1					
	AIC	0.07	0.02	3, 14, 15	6	2	2	2	-
	HQC	0.07	0.02	3					
4	SIC	0.15	0.06	1					
	AIC	0.03	0.06	9, 11, 12, 14, 15	9	3	2	3	-
	HQC	0.06	0.06	3					
5	SIC	0.00	0.00	1					
	AIC	0.00	0.00	3, 13, 14, 15	4	1	1	1	-
	HQC	0.00	0.00	3					
6A	SIC	0.01	0.19	1					
	AIC	0.03	0.19	3, 12, 15	15	4	1	1	-
	HQC	0.03	0.19	3					
6B	SIC	0.73	0.00	1					
	AIC	0.43	0.25	2, 3, 14, 15	2	2	2	1	-
	HQC	0.43	0.00	3					
7	SIC	0.05	0.05	1, 12, 13					
	AIC	0.05	0.05	10, 11, 12, 13, 14, 15	15	3	3	3	-
	HQC	0.05	0.05	10, 11, 12, 13, 14, 15					
8	SIC	0.14	0.17	1					
	AIC	0.334*	0.311*	9, 11, 12, 13, 14, 15	13	5	2	2	0.0363 (lag 7)
	HQC	0.334*	0.311*	8, 14, 15					
9	SIC	0.001	0.003	1					
	AIC	0.860	0.974	4, 9, 10, 14, 15	9	2	2	2	-
	HQC	0.001	0.974	3				(AIC)	
14A	SIC	0.000	0.000	1					
	AIC	0.140	0.145	3, 14, 15	5	3	1	3	-
	HQC	0.157	0.145	3				(AIC)	
15	SIC	0.000	0.000	1					
	AIC	0.000	0.000	8, 11, 12, 13, 14, 15	8	1	0	1	-
	HQC	0.000	0.000	3					
16	SIC	0.000	0.017	1					
	AIC	0.331	0.341	3, 11, 12, 13, 14, 15	11	3	3	3	-
	HQC	0.331	0.341	3					
17	SIC	0.538	0.940	1					
	AIC	0.416	0.940	4, 11, 12, 13, 14, 15	11	5	1	1	-
	HQC	0.538	0.940	3					

Source: Author's calculations, EViews® *integrated of order 2, I(2)

Stability Criteria VEC Model - Categories / China (continued)

Product Category	Information Criteria	ADF Test Results (p-values) QMT	VALUE	Lag Length suggested	selected	Cointegration Relations Trace	Eigenvalue	selected	Auto-correlation
18	SIC	0.228	0.160	1					
	AIC	0.432	0.356	10, 11, 12, 13, 14, 15	3	1	1	1	-
	HQC	0.228	0.160	3					
20	SIC	0.927	1.000	2					
	AIC	0.987	1.000	10, 11, 12, 13, 14, 15	6	3	2	3	0.0209 (lag 5)
	HQC	0.987	0.999	3, 6, 13, 14, 15					
21A	SIC	0.589	0.902	2					
	AIC	0.589	0.965	10, 11, 12, 13, 14, 15	2	1	1	1	-
	HQC	0.589	0.902	3					
21B	SIC	0.230	0.941	1					
	AIC	0.541	0.964	10, 11, 12, 13, 14, 15	10	4	4	4	0.0000 (lag 1)
	HQC	0.541	0.964	10, 11, 12, 13, 14, 15					
21CD	SIC	0.572	0.748	1, 3					
	AIC	0.623*	0.112*	10, 11, 12, 13, 14, 15	4	5	3	3	-
	HQC	0.623*	0.7475	3, 14, 15					
21E	SIC	0.249	0.513	1					
	AIC	0.249	0.513	9, 12, 13, 14, 15	3	1	0	1	-
	HQC	0.249	0.513	3					
22A	SIC	0.296	0.337	1					
	AIC	0.165	0.181	6, 11, 12, 13, 14, 15	15	4	4	4	-
	HQC	0.177	0.369	3, 15					
22B	SIC	0.212	0.260	1					
	AIC	0.212	0.260	10, 11, 12, 13, 14, 15	11	5	2	2	-
	HQC	0.212	0.260	10, 11, 14, 15					
23	SIC	0.238	0.822	1					
	AIC	0.764	0.994	10, 11, 12, 13, 14, 15	11	2	2	2	-
	HQC	0.454	0.994	3					
28	SIC	0.000	0.000	1					
	AIC	0.000	0.039	3, 15	4	1	1	1	-
	HQC	0.000	0.039	3					
29	SIC	0.072	0.096	1					
	AIC	0.547	0.640	3, 15	4	3	0	3	-
	HQC	0.072	0.096	3					
31	SIC	0.229	0.106	1, 2					
	AIC	0.229	0.241	7, 11, 12, 13, 14, 15	2	1	1	1	-
	HQC	0.229	0.338	3					
32	SIC	0.141	0.450	1					
	AIC	0.521	0.968	3, 11, 12, 13, 14, 15	3	2	0	2	-
	HQC	0.521	0.849	3					
33A	SIC	0.436	0.694	2, 3					
	AIC	0.534	0.738	3, 14, 15	3	2	2	2	-
	HQC	0.436	0.694	3					
33B	SIC	0.033	0.004	1					
	AIC	0.033	0.054	3	3	2	1	2	-
	HQC	0.033	0.004	3				(AIC)	
35	SIC	0.000	0.000	1					
	AIC	0.917	0.453	10, 11, 12, 13, 14, 15	4	1	0	1	-
	HQC	0.917	0.453	3, 13, 14, 15				(AIC)	
36	SIC	0.001	0.002	1					
	AIC	0.001	0.002	10, 11, 12, 13, 14, 15	14	1	0	1	0.0245 (lag 4)
	HQC	0.001	0.002	3, 15					
37	SIC	0.448	0.824	1					
	AIC	0.110	0.844	10, 11, 12, 13, 14, 15	4	2	2	2	-
	HQC	0.132*	0.824	4, 5, 14, 15					

Source: Author's calculations, EViews® *integrated of order 2, I(2)

3.3.7.2 Japan

Stability Criteria VEC Model - Categories / Japan

Product Category	Information Criteria	ADF Test Results (p-values) QMT	VALUE	Lag Length suggested	selected	Cointegration Relations Trace	Eigenvalue	selected	Auto-correlation
1A	SIC	0.232	0.241	1					
	AIC	0.069	0.094	4, 13, 14, 15	4	3	0	3	-
	HQC	0.069	0.241	4					
1B	SIC	0.021	0.061	1					
	AIC	0.154	0.276	3, 13, 14, 15	15	5	3	3	-
	HQC	0.021	0.061	3				(AIC)	
3	SIC	0.000	0.259	1					
	AIC	0.022	0.259	3, 13, 14, 15	4	2	0	2	-
	HQC	0.088	0.259	3				(HQC)	
4	SIC	0.000	0.000	1					
	AIC	0.000	0.000	10, 11, 12, 13, 14, 15	10	1	1	1	-
	HQC	0.000	0.000	3					
5	SIC	0.000	0.000	1					
	AIC	0.000	0.000	10, 11, 12, 13, 14, 15	11	1	1	1	0.0333 (lag 4) 0.0167 (lag 7)
	HQC	0.000	0.000	3					
6A	SIC	0.000	0.000	1					
	AIC	0.000	0.804	3, 14, 15	7	2	0	2	-
	HQC	0.000	0.804	3				(AIC)	
7	SIC	0.000	0.000	1					
	AIC	0.230	0.827	4, 11, 13, 14, 15	11	2	1	2	-
	HQC	0.000	0.760	3				(AIC)	
8	SIC	0.000	0.000	1					
	AIC	0.000	0.000	4, 10, 13, 14	10	1	1	1	-
	HQC	0.000	0.000	3					
14	SIC	0.520	0.971	1					
	AIC	0.732	0.990	10, 12, 15	6	1	0	1	-
	HQC	0.520	0.990	3					
14A	SIC	0.801	0.507	1					
	AIC	0.645	0.590	8, 12, 13, 14, 15	8	2	0	2	-
	HQC	0.645	0.590	3					
15	SIC	0.000	0.022	1					
	AIC	0.002	0.022	3, 14, 15	3	1	0	1	-
	HQC	0.002	0.022	3					
16	SIC	0.003	0.063	1					
	AIC	0.003	0.063	3, 15	9	1	1	1	-
	HQC	0.003	0.063	3					
17	SIC	0.130	0.055	1					
	AIC	0.130	0.112	3, 11, 12, 13, 14, 15	12	5	3	3	-
	HQC	0.130	0.055	3					
18	SIC	0.041	0.129	1					
	AIC	0.041	0.303	5, 14, 15	14	4	1	1	-
	HQC	0.041	0.129	3					
19	SIC	0.303	0.545	1, 2					
	AIC	0.443	0.732	3, 11, 12, 13, 14, 15	2	2	0	2	-
	HQC	0.443	0.545	3					
20	SIC	0.000	0.000	1					
	AIC	0.000	0.226	3, 13, 14, 15	4	1	0	1	-
	HQC	0.000	0.000	3					

Source: Author's calculations, EViews®

Stability Criteria VEC Model - Categories / Japan (continued)										
		ADF Test Results (p-values)		Lag Length		Cointegration Relations			
Product Category	Information Criteria	QMT	VALUE	suggested	selected	Trace	Eigenvalue	selected	Auto-correlation
21A	SIC	0.221	0.289	1					
	AIC	0.221	0.289	4, 7, 8, 13, 15	7	2	2	2	-
	HQC	0.221	0.289	3					
21B	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 12, 13, 14, 15	3	1	0	1	-
	HQC	0.000	0.000	3					
21CD	SIC	0.000	0.191	1					
	AIC	0.003	0.191	3, 14, 15	14	3	2	3	-
	HQC	0.003	0.191	3					
21E	SIC	0.000	0.066	1					
	AIC	0.000	0.944	3, 12, 14, 15	6	2	0	2	-
	HQC	0.000	0.066	3					
22A	SIC	0.000	0.001	1					
	AIC	0.000	0.001	4, 15	4	1	0	1	-
	HQC	0.000	0.001	1, 3					
22B	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 14, 15	4	1	0	1	-
	HQC	0.000	0.001	1, 3					
23	SIC	0.224	0.035	1					
	AIC	0.224	0.121	3, 11, 13, 14, 15	11	3	3	3	-
	HQC	0.224	0.035	3				(AIC)	
28	SIC	0.004	0.006	1					
	AIC	0.131	0.166	4, 15	15	4	4	4	-
	HQC	0.131	0.166	3				(AIC)	
29	SIC	0.002	0.001	1					
	AIC	0.000	0.001	3, 4	15	1	1	1	0.0242 (lag 8)
	HQC	0.002	0.001	3, 15					
29A	SIC	0.106	0.059	1					
	AIC	0.057	0.011	10, 11, 12, 14, 15	11	4	4	4	-
	HQC	0.077	0.011	3					
31	SIC	0.000	0.000	1					
	AIC	0.030	0.004	8, 11, 12, 14, 15	8	1	0	1	-
	HQC	0.000	0.004	3					
32	SIC	0.000	0.002	1					
	AIC	0.009	0.002	3, 15	3	1	0	1	-
	HQC	0.009	0.002	3					
33A	SIC	0.001	0.001	1					
	AIC	0.000	0.001	4, 11, 12, 13, 14, 15	11	1	1	1	-
	HQC	0.000	0.001	3, 4					
33B	SIC	0.176	0.380	1					
	AIC	0.176	0.339*	5, 12, 13, 14, 15	8	2	2	2	-
	HQC	0.176	0.771	3, 15					
34	SIC	0.004	0.733	1					
	AIC	0.114	0.856	9, 12, 13, 14, 15	13	5	2	2	-
	HQC	0.004	0.733	3				(AIC)	
35	SIC	0.000	0.195	1					
	AIC	0.274	0.888	4, 12, 13, 14, 15	4	3	0	3	-
	HQC	0.000	0.888	3				(AIC)	
36	SIC	0.453	0.003	1					
	AIC	0.098	0.536	10, 11, 12, 13, 14, 15	11	4	1	1	-
	HQC	0.453	0.536	1, 3					
37	SIC	0.008	0.038	1					
	AIC	0.008	0.013	6, 9, 10, 12, 13, 14, 15	10	1	1	1	-
	HQC	0.008	0.204	3					

Source: Author's calculations, EViews® *integrated of order 2, I(2)

3.3.7.3 South Korea

Stability Criteria VEC Model - Categories / South Korea

Product	Information	ADF Test Results (p-values)		Lag Length		Cointegration Relations			Auto-
Category	Criteria	QMT	VALUE	suggested	selected	Trace	Eigenvalue	selected	correlation
1B	SIC	0.000	0.000	1					
	AIC	0.239	0.000	6, 11, 12, 14, 15	6	1	1	1	-
	HQC	0.000	0.000	3				(AIC)	
3	SIC	0.071	0.127	1					
	AIC	0.457	0.495	3	13	3	2	3	-
	HQC	0.457	0.127	3					
4	SIC	0.000	0.000	1, 3					
	AIC	0.000	0.000	3, 12, 13, 14, 15	15	1	0	1	0.0276 (lag 1)
	HQC	0.000	0.000	3, 15					
6A	SIC	0.064	0.012	1					
	AIC	0.099	0.032	3, 4, 15	3	1	1	1	-
	HQC	0.169	0.157	3					
6B	SIC	0.000	0.000	1					
	AIC	0.000	0.360	10, 11, 12, 13, 14, 15	15	1	0	1	-
	HQC	0.000	0.360	5, 7, 12					
7	SIC	0.000	0.000	1, 12					
	AIC	0.295	0.288	9, 10, 11, 12	9	3	3	3	0.0000 (lag 1)
	HQC	0.387	0.325	3, 11, 12				(AIC)	
8	SIC	0.308	0.165	2, 3					
	AIC	0.308	0.165	10, 11, 12, 13, 14, 15	11	1	1	1	-
	HQC	0.308	0.165	8, 11, 12, 14, 15					
14	SIC	0.014	0.126	1					
	AIC	0.014	0.387	4, 13, 14, 15	4	1	0	1	-
	HQC	0.014	0.332	3, 4					
14A	SIC	0.018	0.409	1					
	AIC	0.042	0.246	9, 11, 12, 13, 14, 15	6	2	2	2	-
	HQC	0.191	0.409	4, 14, 15				(HQC)	
16	SIC	0.132	0.003	1					
	AIC	0.466	0.667	9, 12, 13, 14, 15	15	3	3	3	-
	HQC	0.466	0.667	3				(AIC)	
18	SIC	0.119	0.165						
	AIC	0.420	0.428	3, 13, 14, 15	6	1	0	1	0.0121 (lag 6)
	HQC	0.119	0.165	3, 15					
19	SIC	0.017	0.102	1, 3					
	AIC	0.285	0.266	3, 10, 14, 15	15	3	3	3	0.0382 (lag 1), 0.0374 (lag 12)
	HQC	0.285	0.266	3					
20	SIC	0.000	0.002	1					
	AIC	0.000	0.004	3, 15	4	1	0	1	-
	HQC	0.000	0.002	3					
21A	SIC	0.345	0.519	1					
	AIC	0.284	0.396	3, 13, 14, 15	3	2	1	2	-
	HQC	0.524	0.519	3					
21B	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 13, 14, 15	3	2	0	2	-
	HQC	0.000	0.000	3				(AIC)	
21CD	SIC	0.002	0.338	1					
	AIC	0.036	0.494	3, 14, 15	3	1	0	1	-
	HQC	0.002	0.338	3					

Source: Author's calculations, EViews®

Stability Criteria VEC Model - Categories / South Korea (continued)										
		ADF Test Results (p-values)		Lag Length		Cointegration Relations			Auto-correlation
Product Category	Information Criteria	QMT	VALUE	suggested	selected	Trace	Eigenvalue	selected	
21E	SIC	0.000	0.000	1, 3, 4, 15					
	AIC	0.000	0.000	10, 11, 12, 13, 14, 15	3	1	1	1	0.041 (lag 2), 0.0000 (lag 3)
	HQC	0.000	0.000	10, 11, 12, 13, 14, 15					
22A	SIC	0.005	0.339	1, 2					
	AIC	0.404	0.395	3, 11, 12, 13, 15	12	2	2	2	0.0283 (lag 4)
	HQC	0.301	0.339	3					
22B	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 13, 14	3	1	1	1	-
	HQC	0.000	0.000	3					
29	SIC	0.001	0.000	1					
	AIC	0.467	0.000	3, 12, 13, 14, 15	7	1	1	1	-
	HQC	0.001	0.000	3				(AIC)	
31	SIC	0.649	0.605	1, 3					
	AIC	0.113	0.157*	10, 11, 12, 13, 15	11	2	3	3	-
	HQC	0.649	0.605	3					
32	SIC	0.038	0.047	1					
	AIC	0.038	0.047	3, 14, 15	3	1	1	1	-
	HQC	0.038	0.047	3					
33A	SIC	0.129	0.149	1					
	AIC	0.129	0.149	5, 11, 12, 13, 14, 15	15	4	3	4	0.0246 (lag 3)
	HQC	0.129	0.149	3, 15					
33B	SIC	0.234	0.249	1					
	AIC	0.138	0.185	4, 10, 11, 13, 14, 15	10	4	2	4	-
	HQC	0.138	0.185	3					
34	SIC	0.387	0.194	1, 3					
	AIC	0.249	0.194	4, 10, 12, 13, 14, 15	10	2	2	2	-
	HQC	0.387	0.194	3, 4, 15					
35	SIC	0.001	0.096	1, 2, 12, 13					
	AIC	0.046	0.049	10, 12, 13	3	1	1	1	-
	HQC	0.046	0.049	10, 12, 13				(AIC)	
36	SIC	0.000	0.000	1					
	AIC	0.611	0.000	5, 12, 13, 14, 15	7	1	1	1	-
	HQC	0.009	0.000	3				(AIC)	
37	SIC	0.000	0.007	1					
	AIC	0.000	0.319	3, 10, 15	10	2	2	2	-
	HQC	0.000	0.007	3				(AIC)	

Source: Author's calculations, EViews®   *integrated of order 2, I(2)

3.3.7.4 Taiwan

Stability Criteria VEC Model - Categories / Taiwan

Product Category	Information Criteria	ADF Test Results (p-values) QMT	VALUE	Lag Length suggested	selected	Cointegration Relations Trace	Eigenvalue	selected	Auto-correlation
1A	SIC	0.000	0.000	1					
	AIC	0.001	0.002	3	3	1	1	1	-
	HQC	0.000	0.002	3					
1B	SIC	0.000	0.000	1					
	AIC	0.000	0.000	5, 15	4	1	0	1	-
	HQC	0.000	0.000	3					
3	SIC	0.029	0.077	1					
	AIC	0.077	0.012	10, 11, 12, 13, 14, 15	11	2	0	2	-
	HQC	0.029	0.012	3				(AIC)	
4	SIC	0.001	0.000	5					
	AIC	0.086	0.096	8, 9, 11, 13, 14, 15	8	2	1	2	-
	HQC	0.086	0.096	9				(AIC)	
6A	SIC	0.052	0.035	1					
	AIC	0.052	0.654	3, 12, 13, 14, 15	2	2	2	2	-
	HQC	0.052	0.035	3				(AIC)	
6B	SIC	0.009	0.336	1					
	AIC	0.009	0.046	9, 11, 12, 13, 15	5	1	0	1	0.0148 (lag 5)
	HQC	0.009	0.336	3					
7	SIC	0.000	0.000	10, 12, 15					
	AIC	0.000	0.168	10, 11, 12, 13, 14, 15	12	1	1	1	-
	HQC	0.000	0.168	10, 11, 12, 13, 14, 15				(AIC)	
14	SIC	0.000	0.446	1					
	AIC	0.066	0.998	10, 11, 13, 14, 15	13	2	2	2	-
	HQC	0.008	0.998	3					
14A	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3	3	1	1	1	-
	HQC	0.000	0.000	3					
16	SIC	0.823	0.791	1					
	AIC	0.823	0.961	10, 11, 12, 13, 14, 15	13	5	3	3	-
	HQC	0.823	0.791	3					
17	SIC	0.230	0.182	1, 2					0.0000 (lag 1),
	AIC	0.230	0.246	10, 11, 12	8	4	4	4	0.0000 (lag 2),
	HQC	0.230	0.182	3, 12					0.0218 (lag 7)
18	SIC	0.557	0.539	1, 3					
	AIC	0.004	0.009	10, 11, 12, 13, 14, 15	12	5	2	2	-
	HQC	0.557	0.539	3					
19	SIC	0.031	0.160	1					
	AIC	0.110	0.463	4, 11, 12, 13, 14, 15	12	5	2	2	-
	HQC	0.110	0.081	3, 15				(AIC)	
20	SIC	0.084	0.117	1					
	AIC	0.048	0.111	3, 11, 12, 13, 14, 15	13	5	3	3	-
	HQC	0.048	0.111	3					
21A	SIC	0.008	0.085	3					
	AIC	0.008	0.085	10, 11, 13, 14, 15	10	1	0	1	0.0021 (lag 2)
	HQC	0.008	0.085	3, 11, 14, 15					
21CD	SIC	0.012	0.268	1					
	AIC	0.051	0.268	10, 11, 12, 13, 14, 15	13	5	3	3	0.0495 (lag 7)
	HQC	0.051	0.268	3				(AIC)	
21E	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 15	3	1	1	1	-
	HQC	0.000	0.000	1, 2					

Source: Author's calculations, EViews®

Stability Criteria VEC Model - Categories / Taiwan (continued)										
Product Category	Information Criteria	ADF Test Results (p-values)		Lag Length		Cointegration Relations			Auto-correlation
		QMT	VALUE	suggested	selected	Trace	Eigenvalue	selected	
22A	SIC	0.000	0.004	3, 12, 13, 14	13	1	0	1 (AIC)	0.0441 (lag 1), 0.0389 (lag 2), 0.0002 (lag 3)
	AIC	0.039	0.488	10, 11, 12, 13, 14, 15					
	HQC	0.039	0.139	3, 11, 12, 13, 14, 15					
23	SIC	0.406	0.171	2	4	2	0	2	-
	AIC	0.062*	0.171	3, 4, 14, 15					
	HQC	0.255	0.171	3					
29	SIC	0.000	0.000	1	3	1	1	1	-
	AIC	0.000	0.000	3, 14, 15					
	HQC	0.000	0.000	2					
31	SIC	0.227	0.139	3, 7, 8, 9, 11	10	3	2	3	0.0474 (lag 5)
	AIC	0.227	0.139	10, 11, 12, 13, 14, 15					
	HQC	0.227	0.139	10, 11, 14, 15					
32	SIC	0.000	0.004	1	3	1	1	1	-
	AIC	0.000	0.003	3, 12, 13, 14, 15					
	HQC	0.000	0.004	3					
33A	SIC	0.320	0.357	1, 2	11	2	2	2	0.0276 (lag 2)
	AIC	0.320	0.329	9, 11, 12, 13, 14, 15					
	HQC	0.320	0.264	3, 14, 15					
33B	SIC	0.284	0.465	1	3	2	0	2	-
	AIC	0.154	0.117	4, 11, 12, 14, 15					
	HQC	0.154	0.117	3, 14, 15					
34	SIC	0.322	0.279	1	2	2	2	2	-
	AIC	0.359	0.231	3, 11, 13, 14, 15					
	HQC	0.322	0.279	3					
36	SIC	0.095	0.223	1	3	2	0	2 (AIC)	-
	AIC	0.144	0.040	3, 11, 12, 15					
	HQC	0.030	0.125	3, 15					
37	SIC	0.051	0.000	1	12	2	1	2 (AIC)	-
	AIC	0.000	0.311	10, 11, 12, 13, 14, 15					
	HQC	0.000	0.311	3					

Source: Author's calculations, EViews® *integrated of order 2, I(2)

3.3.8 Oceania (Australia)

Stability Criteria VEC Model - Categories / Australia

Product Category	Information Criteria	ADF Test Results (p-values) QMT	VALUE	Lag Length suggested	selected	Cointegration Relations Trace	Eigenvalue	selected	Auto-correlation
1A	SIC	0.000	0.000	1					
	AIC	0.032	0.395	3, 15	3	2	0	2	-
	HQC	0.032	0.082	3				(AIC)	
1B	SIC	0.002	0.000	1					
	AIC	0.002	0.001	3, 9, 12, 15	9	1	1	1	-
	HQC	0.002	0.001	3					
4	SIC	0.000	0.000	1					
	AIC	0.000	0.000	4, 15	4	1	1	1	-
	HQC	0.000	0.000	3					
6A	SIC	0.015	0.098	1					
	AIC	0.079	0.098	3, 15	3	1	1	1	-
	HQC	0.015	0.098	3					
6B	SIC	0.000	0.000	1					
	AIC	0.000	0.778	3, 15	3	1	1	1	-
	HQC	0.000	0.000	3					
9	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 15	5	1	1	1	-
	HQC	0.000	0.000	3					
14	SIC	0.000	0.000	1, 3					
	AIC	0.000	0.000	6, 10, 11, 13, 14, 15	13	1	1	1	-
	HQC	0.000	0.000	3, 10, 11					
15	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 15	4	1	1	1	-
	HQC	0.000	0.000	3					
16	SIC	0.294	0.260	1					
	AIC	0.434	0.456	3, 14, 15	7	1	1	1	-
	HQC	0.393	0.260	3					
17	SIC	0.000	0.000	1					
	AIC	0.166	0.019	3	3	1	1	1	-
	HQC	0.000	0.000	3					
18	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 8, 15	8	1	0	1	-
	HQC	0.000	0.000	3					
19	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 15	6	1	1	1	-
	HQC	0.000	0.000	3					
21A	SIC	0.000	0.000	1					
	AIC	0.000	0.143	3	4	2	1	1	-
	HQC	0.000	0.000	3				(AIC)	
21CD	SIC	0.000	0.000	1					
	AIC	0.000	0.030	4, 12, 13, 14, 15	13	1	1	1	-
	HQC	0.000	0.030	3					
21E	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 15	3	1	1	1	-
	HQC	0.000	0.000	3					
22A	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 15	3	1	1	1	-
	HQC	0.000	0.000	3					

Source: Author's calculations, EViews®

Stability Criteria VEC Model - Categories / Australia (continued)										
		ADF Test Results (p-values)		Lag Length		Cointegration Relations			
Product Category	Information Criteria	QMT	VALUE	suggested	selected	Trace	Eigenvalue	selected	Auto-correlation
23	SIC	0.076	0.000	1					
	AIC	0.076	0.002	3, 13, 14, 15	13	2	2	2	-
	HQC	0.076	0.000	3					
28	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 11, 12, 13, 14, 15	13	1	1	1	-
	HQC	0.000	0.000	3					
29	SIC	0.420	0.415	1					
	AIC	0.056	0.098	10, 12, 13, 14, 15	15	4	4	4	0.0409 (lag 5)
	HQC	0.420	0.415	3, 12, 14, 15					
29A	SIC	0.000	0.000	1					
	AIC	0.000	0.000	3, 13, 14, 15	8	1	0	1	-
	HQC	0.000	0.000	3					
31	SIC	0.000	0.999	1					
	AIC	0.239	0.999	3, 14, 15	3	2	2	2	-
	HQC	0.000	0.999	3					
32	SIC	0.000	0.000	1					
	AIC	0.001	0.000	3, 10, 11, 13, 14, 15	10	1	1	1	-
	HQC	0.000	0.000	3					
34	SIC	0.000	0.000	1					
	AIC	0.001	0.000	3, 15	3	1	1	1	-
	HQC	0.000	0.000	3					
36	SIC	0.000	0.000	1					
	AIC	0.000	0.000	6, 13, 14, 15	6	1	1	1	-
	HQC	0.000	0.000	3					
37	SIC	0.303	0.344	1					
	AIC	0.187*	0.344	8, 9, 12, 13, 14, 15	9	3	1	3	0.0436 (lag 2) 0.0432 (lag 3)
	HQC	0.303	0.344	3					

Source: Author's calculations, EViews® *integrated of order 2, I(2)

3.4 VECM t-Statistics and Adjustment Vectors for Steel Exporting Countries

The econometric analysis focuses on the interpretation of the impulse response and variance decomposition estimates and on the Granger causality test results but not on cointegration analysis. Although the adjustment vectors and the corresponding t-statistics of the VECMs have not been included in the analysis, they are reported in the appendix as additional indicators for the stability of the VEC models.

3.4.1 European Union

Adjustment Vectors - t-Statistics (QMT) - EU

Country	Cointegrating Equation	Adjustment Vector	t-Statistic
Austria	Eq 1	109.4389	3.257
	Eq 2	-2.0837	-3.347
Belgium	Eq 1	-2,491.5730	-4.319
	Eq 2	-0.9534	-1.203
	Eq 3	0.0021	1.893
Bulgaria	Eq 1	-422.9220	-2.553
Czech Republic	Eq 1	-247.4633	-3.589
	Eq 2	-0.3149	-2.797
Denmark	Eq 1	1.5616	1.515
	Eq 2	-0.3729	-1.665
	Eq 3	-0.0001	-0.840
Estonia	Eq 1	-693.6754	-2.646
Finland	Eq 1	134.5971	0.843
	Eq 2	-2.2452	-3.234
	Eq 3	0.0021	2.146
France	Eq 1	9.2518	0.039
	Eq 2	-0.2088	-0.395
	Eq 3	-0.0007	-1.145
Germany	Eq 1	-445.8797	-1.202
	Eq 2	-0.4257	-2.276
Hungary	Eq 1	-63.8345	-2.431
Ireland	Eq 1	-39.9937	-4.822
Italy	Eq 1	173.7128	0.376
	Eq 2	-1.7719	-4.232
	Eq 3	0.0007	1.154
Latvia	Eq 1	-357.7281	-1.565
	Eq 2	0.7545	1.495
Lithuania	Eq 1	4.4807	0.931
Luxembourg	Eq 1	-275.6786	-1.647
	Eq 2	-0.4282	-1.633
Netherlands	Eq 1	-1,893.9450	-1.603

Adjustment Vectors - t-Statistics (QMT) - EU (continued)

Country	Cointegrating Equation	Adjustment Vector	t-Statistic
Poland	Eq 1	-333.0198	-1.480
	Eq 2	-0.9794	-1.591
Portugal	Eq 1	15.7095	0.710
	Eq 2	-0.7462	-2.216
	Eq 3	0.0005	0.659
Romania	Eq 1	-2,747.2690	-1.734
	Eq 2	-0.6597	-0.789
Slovakia	Eq 1	302.1989	1.180
	Eq 2	3.7012	1.167
Spain	Eq 1	-33.7023	-0.216
	Eq 2	-0.1712	-0.951
Sweden	Eq 1	-297.6645	-1.012
	Eq 2	-0.1131	-0.272
United Kingdom	Eq 1	-367.5443	-2.464
	Eq 2	-0.4738	-3.702

3.4.2 Other Europe

Adjustment Vectors and t-Statistics - Other Europe

Country	Cointegrating Equation	Adjustment Vector	t-Statistic
Norway	Eq 1	-136.9150	-0.517
	Eq 2	0.1832	0.190
Switzerland	Eq 1	-13.6130	-4.597
	Eq 2	-1.2914	-5.164

3.4.3 C.I.S.

Adjustment Vectors and t-Statistics - C.I.S.

Country	Cointegrating Equation	Adjustment Vector	t-Statistic
Kazakhstan	Eq 1	-660.8558	-1.667
Russia	Eq 1	-639.3906	-2.153
Ukraine	Eq 1	-1,457.7510	-3.350

3.4.4 North America

Adjustment Vectors and t-Statistics - North America			
Country	Cointegrating Equation	Adjustment Vector	t-Statistic
Canada	Eq 1	-4,879.7990	-1.110
	Eq 2	1.0233	1.252
	Eq 3	-0.0006	-0.634
	Eq 4	-488,682.4000	-1.183
Costa Rica	Eq 1	-61.8205	-1.558
	Eq 2	-2.6289	-0.663
Dominican Republic	Eq 1	189.8433	0.350
	Eq 2	0.9128	0.398
El Salvador	Eq 1	-71.2189	-1.297
	Eq 2	1.7959	1.806
	Eq 3	-0.0062	-1.861
Guatemala	Eq 1	-21.6842	-5.130
Honduras	Eq 1	0.1897	0.300
Mexico	Eq1	-731.6192	-0.880
Panama	Eq 1	2.0456	0.725
	Eq 2	5.1524	0.364
Trinidad and Tobago	Eq 1	891.7730	2.368
	Eq 2	-2.1937	-2.147

3.4.5 South America

Adjustment Vectors and t-Statistics - South America			
Country	Cointegrating Equation	Adjustment Vector	t-Statistic
Argentina	Eq 1	240.7310	0.896
	Eq 2	-3.2123	-4.677
Brazil	Eq 1	2,031.7480	1.688
Chile	Eq 1	-27.6903	-0.157
	Eq 2	0.0726	0.164
Colombia	Eq 1	191.3883	2.884
	Eq 2	-0.5323	-1.340
Ecuador	Eq 1	1.6976	4.327
Peru	Eq 1	29.2465	2.977
	Eq 2	1.5171	1.943
Uruguay	Eq1	0.2037	0.061

3.4.6 Africa

Adjustment Vectors and t-Statistics - Africa

Country	Cointegrating Equation	Adjustment Vector	t-Statistic
Algeria	Eq 1	150.7566	1.554
Egypt	Eq 1	-1,502.4540	-0.869
	Eq 2	2.5266	2.123
South Africa	Eq 1	415.1586	3.734

3.4.7 Middle East

Adjustment Vectors and t-Statistics - Middle East

Country	Cointegrating Equation	Adjustment Vector	t-Statistic
Israel	Eq 1	-440.7049	-5.811
Saudi Arabia	Eq 1	-126.6160	-4.830
Turkey	Eq 1	2,017.0290	0.950
	Eq 2	-3.2439	-3.105
	Eq 3	0.0044	3.054
United Arab Emirates	Eq 1	-61.0131	-2.089

3.4.8 Asia

Adjustment Vectors and t-Statistics - Asia

Country	Cointegrating Equation	Adjustment Vector	t-Statistic
China	Eq 1	1,604.7290	2.570
	Eq 2	0.0864	1.336
Hong Kong	Eq 1	-19.1526	-0.747
	Eq 2	-1.1050	-0.725
	Eq 3	0.0004	0.126
India	Eq 1	1,155.0280	0.723
	Eq 2	-2.0610	-3.252
	Eq 3	0.0010	0.885
Indonesia	Eq 1	-268.2634	-0.814
	Eq 2	1.3583	1.833
	Eq 3	-0.0057	-2.118
Japan	Eq 1	3,738.3550	1.152
	Eq 2	0.2712	0.238
	Eq 3	-0.0016	-0.702

Adjustment Vectors and t-Statistics - Asia (continued)			
Country	Cointegrating Equation	Adjustment Vector	t-Statistic
Malaysia	Eq 1	23.0664	0.034
Philippines	Eq 1	-35.5861	-4.722
Singapore	Eq 1	44.3068	1.172
South Korea	Eq 1	206.5761	1.803
Taiwan	Eq 1	1,308.2550	0.872
	Eq 2	-0.4862	-0.425
	Eq 3	0.0003	0.173
Thailand	Eq 1	124.7154	0.483
	Eq 2	0.5369	2.697

3.4.9 Oceania

Adjustment Vectors and t-Statistics - Oceania			
Country	Cointegrating Equation	Adjustment Vector	t-Statistic
Australia	Eq 1	-1,233.4160	-1.199
	Eq 2	0.6698	0.908
New Zealand	Eq 1	53.3073	0.797
	Eq 2	-0.4543	-1.506
	Eq 3	-0.0008	-1.703

3.5 VECM t-Statistics and Adjustment Vectors for Steel Export Categories

The econometric analysis focuses on the interpretation of the impulse response and variance decomposition estimates and on the Granger causality test results but not on cointegration analysis. Although the adjustment vectors and the corresponding t-statistics of the VECMs have not been included in the analysis, they are reported in the appendix as additional indicators for the stability of the VEC models.

3.5.1 European Union

3.5.1.1 Belgium

Adjustment Vectors - t-Statistics (QMT) - Belgium			
Product Category	Cointegrating Equation	Adjustment Vector	t-Statistic
1A	Eq 1	-1.2832	-0.414
	Eq 2	-1.0826	-3.143
1B	Eq 1	146.4816	4.186
3	Eq 1	-93.4076	-0.346
	Eq 2	-0.1028	-0.023
	Eq 3	-0.0065	-0.358
	Eq 4	11,162.1700	0.370
4	Eq 1	-2.5584	-2.338
	Eq 2	-1.4125	-2.717
6A	Eq 1	-68.2287	-1.154
6B	Eq 1	-7.1990	-0.606
	Eq 2	-0.2771	-1.675
7	Eq 1	-5.1695	-2.402
8	Eq 1	-0.0670	-4.501
14	Eq 1	-1.3929	-0.466
	Eq 2	0.3979	1.954
14A	Eq 1	1.1611	1.880
	Eq 2	-2.1827	1.880
15	Eq 1	-5.3121	-5.032
16	Eq 1	0.0728	0.521
	Eq 2	-0.4138	-1.322
17	Eq 1	-0.3144	-0.209
	Eq 2	0.4430	0.627
18	Eq 1	10.8940	3.182
19	Eq 1	0.1604	2.600
20	Eq 1	-0.4871	-1.551
21A	Eq 1	0.1810	5.558
21B	Eq 1	0.1364	4.656

Adjustment Vectors - t-Statistics (QMT) - Belgium (continued)			
Product Category	Cointegrating Equation	Adjustment Vector	t-Statistic
21CD	Eq 1	-0.0492	-0.142
	Eq 2	-1.7633	-3.952
21E	Eq 1	0.0384	0.205
	Eq 2	-2.6186	-3.063
23	Eq 1	-1.2404	-0.521
	Eq 2	-2.3973	-3.522
28	Eq 1	-14.5696	-2.127
	Eq 2	0.5078	0.949
29	Eq 1	-19.8482	-2.272
	Eq 2	0.5100	0.610
29A	Eq 1	-21.2225	-2.677
31	Eq 1	-77.8045	-1.295
	Eq 2	-0.9614	-2.585
32	Eq 1	-4.0595	-0.044
	Eq 2	-0.8444	-3.798
33A	Eq 1	14.0327	0.927
	Eq 2	-1.1851	-4.266
33B	Eq 1	-15.3166	-2.286
	Eq 2	-1.3070	-3.127
34	Eq 1	-47.6491	-1.707
	Eq 2	-0.3129	-0.218
35	Eq 1	1.1559	2.769
	Eq 2	3.8904	1.044
36	Eq 1	-0.1245	-2.037
37	Eq 1	-8.0599	-4.280
	Eq 2	1.9333	1.236

3.5.1.2 France

Adjustment Vectors - t-Statistics (QMT) - France			
Product Category	Cointegrating Equation	Adjustment Vector	t-Statistic
1B	Eq 1	-4.0531	-0.555
	Eq 2	0.1181	0.299
3	Eq 1	-424.3245	-3.584
4	Eq 1	-1.4332	-3.237
	Eq 2	-1.0248	-1.671
6A	Eq 1	4.7470	0.883
	Eq 2	-0.4792	-6.172
6B	Eq 1	23.1694	5.151
7	Eq 1	29.1126	0.813
	Eq 2	-7.4280	-3.651
	Eq 3	0.0130	2.828
	Eq 4	-339.1865	-0.084
14	Eq 1	-18.8898	-1.866
	Eq 2	-0.7345	-3.580
14A	Eq 1	0.1741	2.549
	Eq 2	-0.1453	-0.416
16	Eq 1	20.8084	2.866
17	Eq 1	-3.6983	-0.498
18	Eq 1	2.2265	0.582
	Eq 2	-0.5574	-3.025
	Eq 3	0.0003	1.330
19	Eq 1	-51.9076	-1.408
20	Eq 1	-48.4515	-3.493
	Eq 2	-0.3774	-0.785
	Eq 3	-0.0007	-0.818
21A	Eq 1	-38.6933	-2.271
	Eq 2	-2.0306	-3.402
21B	Eq 1	-1.9200	-0.213
21CD	Eq 1	15.3168	1.043
	Eq 2	-3.0063	-1.976
21E	Eq 1	-0.2465	-5.519
22A	Eq 1	1.8108	5.019
23	Eq 1	-9.8670	-0.502
	Eq 2	0.3153	0.491
	Eq 3	-0.0001	-0.124
28	Eq 1	11.1937	0.938
	Eq 2	4.4837	1.934
	Eq 3	-0.0101	-2.075
29	Eq 1	-35.0084	-4.432
	Eq 2	0.0648	0.115

Adjustment Vectors - t-Statistics (QMT) - France (continued)			
Product Category	Cointegrating Equation	Adjustment Vector	t-Statistic
29A	Eq 1	-35.0084	-4.432
	Eq 2	0.0648	0.115
31	Eq 1	3.9307	0.071
	Eq 2	-1.2842	-4.298
32	Eq 1	61.6745	1.203
	Eq 2	0.1269	0.211
	Eq 3	-0.0007	-0.893
33A	Eq 1	-11.5085	-0.915
	Eq 2	-1.7765	-2.826
33B	Eq 1	1.0610	1.458
	Eq 2	-2.6503	-1.964
34	Eq 1	-2.0414	-3.948
35	Eq 1	-3.9567	-1.035
36	Eq 1	0.2663	2.735
37	Eq 1	-1.6521	-1.287
	Eq 2	-0.7175	-4.362

3.5.1.3 Germany

Adjustment Vectors - t-Statistics (QMT) - Germany			
Product Category	Cointegrating Equation	Adjustment Vector	t-Statistic
1A	Eq 1	-4.4998	-4.128
	Eq 2	-0.9002	-2.755
1B	Eq 1	-499.5066	-3.456
	Eq 2	-0.4032	-1.073
3	Eq 1	-304.3777	-2.906
	Eq 2	-1.2377	-2.944
4	Eq 1	-2.3952	-0.056
	Eq 2	0.7181	1.794
5	Eq 1	7.5035	0.605
	Eq 2	-1.7281	-2.296
6A	Eq 1	-44.5867	-1.177
	Eq 2	-1.2139	-5.538
	Eq 3	0.0002	0.942
6B	Eq 1	-102.9320	-2.193
7	Eq 1	-2.3340	-0.124
	Eq 2	-0.2042	-0.090

Adjustment Vectors - t-Statistics (QMT) - Germany (continued)

Product Category	Cointegrating Equation	Adjustment Vector	t-Statistic
8	Eq 1	0.5097	1.747
9	Eq 1	-1.1292	-6.039
14	Eq 1	-40.6661	-0.715
14A	Eq 1	6.6897	2.280
	Eq 2	0.8041	3.527
15	Eq 1	-27.1994	-0.301
	Eq 2	-1.7403	-4.429
16	Eq 1	-80.9031	-2.187
	Eq 2	-0.4253	-0.413
	Eq 3	0.0001	0.074
17	Eq 1	-14.1245	-1.530
	Eq 2	-0.6742	-2.427
	Eq 3	-0.0001	-1.013
18	Eq 1	6.4915	5.576
19	Eq 1	-0.1777	-0.006
20	Eq 1	-73.5025	-0.287
	Eq 2	-1.7637	-2.551
21A	Eq 1	12.4038	0.667
	Eq 2	0.0737	0.471
21B	Eq 1	-52.6237	-0.653
	Eq 2	-1.4976	-1.780
	Eq 3	0.0003	0.743
21CD	Eq 1	1.8935	1.667
21E	Eq 1	-0.2974	-0.513
	Eq 2	-0.3703	-3.135
22A	Eq 1	-8.1221	-2.295
	Eq 2	-0.6917	-1.656
23	Eq 1	-33.8754	-2.171
	Eq 2	-0.4054	-0.387
28	Eq 1	-5.5775	-2.179
29	Eq 1	23.5413	1.931
29A	Eq 1	10.6050	4.546
31	Eq 1	70.80	2.411
32	Eq 1	-39.37	-0.827
33A	Eq 1	12.25	0.207
	Eq 2	-1.56	-4.159
33B	Eq 1	82.98	1.733
	Eq 2	0.29	0.638
	Eq 3	0.00	-0.918
34	Eq 1	6.27	4.676
	Eq 2	-0.58	-2.242

Adjustment Vectors - t-Statistics (QMT) - Germany (continued)			
Product Category	Cointegrating Equation	Adjustment Vector	t-Statistic
35	Eq 1	-72.18	-3.384
	Eq 2	-1.91	-3.381
36	Eq 1	-19.04	-3.423
	Eq 2	-0.38	-0.425
37	Eq 1	-8.02	-1.034
	Eq 2	-1.01	-3.138

3.5.1.4 Italy

Adjustment Vectors - t-Statistics (QMT) - Italy			
Product Category	Cointegrating Equation	Adjustment Vector	t-Statistic
1A	Eq 1	-90.0540	-2.288
	Eq 2	-0.3511	-0.489
	Eq 3	0.0005	1.931
1B	Eq 1	-799.2350	-2.228
	Eq 2	1.0638	0.758
	Eq 3	-0.0036	-1.077
3	Eq 1	-176.3666	-2.179
	Eq 2	-1.1444	-2.622
4	Eq 1	-46.0468	-0.452
6A	Eq 1	-48.5758	-5.592
6B	Eq 1	-60.9008	-3.238
7	Eq 1	-14.8032	-4.289
14	Eq 1	4.3110	0.322
	Eq 2	-0.6197	-3.394
14A	Eq 1	-13.6152	-3.190
	Eq 2	-1.5968	-2.772
15	Eq 1	-244.8792	-1.720

Adjustment Vectors - t-Statistics (QMT) - Italy (continued)

Product Category	Cointegrating Equation	Adjustment Vector	t-Statistic
16	Eq 1	-10.5830	-0.729
	Eq 2	0.0590	0.413
17	Eq 1	-13.9930	-4.190
18	Eq 1	1.1531	0.044
	Eq 2	-3.1321	-2.089
	Eq 3	0.0009	1.803
19	Eq 1	10.7226	3.117
20	Eq 1	-1,045.3150	-2.922
	Eq 2	-1,045.3150	-2.965
	Eq 3	0.0049	3.037
21A	Eq 1	-39.1631	-2.005
	Eq 2	-0.8066	-1.978
21B	Eq 1	0.4220	0.186
21CD	Eq 1	0.5608	1.308
21E	Eq 1	-0.2236	-1.488
22A	Eq 1	0.9170	1.386
23	Eq 1	0.2991	0.049
	Eq 2	-0.2626	-2.878
31	Eq 1	-489.1568	-2.665
	Eq 2	0.5402	1.235
32	Eq 1	-22.8955	-3.452
33A	Eq 1	-8.3609	-0.602
	Eq 2	-0.6464	-2.474
34	Eq 1	-7.9034	-1.918
	Eq 2	0.7919	0.224
	Eq 3	-0.0013	-0.377
35	Eq 1	-0.2589	-0.195
36	Eq 1	0.5803	0.596
		-1.2854	-2.664
37	Eq 1	1.0223	1.902
	Eq 2	-0.0584	-0.192

3.5.1.5 Netherlands

Adjustment Vectors and t-Statistics - Netherlands			
Product Category	Cointegrating Equation	Adjustment Vector	t-Statistic
1B	Eq 1	-158.2165	-2.979
	Eq 2	-1.3359	-2.130
3	Eq 1	-0.2814	-4.495
4	Eq 1	0.4340	0.248
6A	Eq 1	0.5165	0.206
6B	Eq 1	-955.0081	-2.645
14	Eq 1	-4.9343	-1.987
	Eq 2	0.0036	0.011
14A	Eq 1	6.5984	2.457
	Eq 2	13.9039	1.751
	Eq 3	-0.0346	-1.882
	Eq 4	-458.9608	-1.786
16	Eq 1	0.3687	1.206
	Eq 2	-1.0007	-3.715
	Eq 3	-0.0001	-0.805
17	Eq 1	2.4577	0.675
	Eq 2	0.3398	1.698
18	Eq 1	-14.3608	-2.623
	Eq 2	-0.9353	-3.538
19	Eq 1	0.9462	3.981
	Eq 2	-0.4591	-2.419
20	Eq 1	-2.9680	-2.363
21A	Eq 1	-0.1224	-0.129
	Eq 2	0.3151	1.441
21B	Eq 1	-3.5488	-2.827
	Eq 2	-0.3637	-0.720
21CD	Eq 1	-0.3719	-0.372
21E	Eq 1	0.0126	1.111
22A	Eq 1	1.3131	3.021
23	Eq 1	0.2564	5.731
28	Eq 1	-4.2205	-5.323
29	Eq 1	-20.9963	-0.866
	Eq 2	-3.4503	-3.353
29A	Eq 1	-37.9816	-3.381
	Eq 2	0.1739	0.109
31	Eq 1	-12.5053	-1.334
32	Eq 1	-55.6561	-0.634
	Eq 1	-31.5317	-2.156
33A	Eq 2	0.2171	1.657
34	Eq 1	-0.4055	-0.220
	Eq 2	-2.1113	-3.177
37	Eq 1	-2.2471	-3.375
	Eq 2	2.1618	3.568

3.5.1.6 Spain

Adjustment Vectors and t-Statistics - Spain			
Product Category	Cointegrating Equation	Adjustment Vector	t-Statistic
1B	Eq 1	-52.3848	-1.063
	Eq 2	-0.3565	-2.566
3	Eq 1	-37.8407	-2.968
4	Eq 1	172.3852	1.537
	Eq 2	-2.1179	-3.392
6A	Eq 1	1.8409	3.952
6B	Eq 1	7.0068	2.314
7	Eq 1	1.6814	0.330
	Eq 2	-1.3566	-2.874
	Eq 3	0.0003	0.251
8	Eq 1	-1.6385	-3.614
14	Eq 1	-44.3439	-1.907
	Eq 2	-0.8883	-3.448
14A	Eq 1	2.7831	2.143
	Eq 2	-1.6888	-2.055
16	Eq 1	18.5525	5.396
17	Eq 1	-3.0444	-1.124
	Eq 2	0.1644	0.390
18	Eq 1	25.5816	3.837
19	Eq 1	21.8637	0.871
	Eq 2	0.0590	0.480
	Eq 3	-0.0004	-1.882
20	Eq 1	8.0482	2.915
	Eq 2	-4.8758	-2.392
21A	Eq 1	2.9650	0.233
	Eq 2	-0.5170	-1.612
	Eq 3	-0.0002	-0.949
21B	Eq 1	-6.1317	-3.246
	Eq 2	-0.6990	-2.009
	Eq 3	0.0002	1.308
21CD	Eq 1	-6.5125	-0.862
	Eq 2	-1.0915	-1.084
21E	Eq 1	-0.0079	-0.114
	Eq 2	-25.8618	-3.945
22A	Eq 1	-0.2798	-1.807
23	Eq 1	-1.3861	-1.727
29	Eq 1	18.1083	3.184
	Eq 2	-1.1491	-1.877
31	Eq 1	17.1035	3.258

Adjustment Vectors and t-Statistics - Spain (continued)			
Product Category	Cointegrating Equation	Adjustment Vector	t-Statistic
32	Eq 1	-0.7945	-0.336
	Eq 2	-0.0455	-0.189
33A	Eq 1	-129.5359	-3.014
	Eq 2	-0.3655	-1.308
	Eq 3	-0.0014	-1.386
33B	Eq 1	-7.0179	-4.730
34	Eq 1	0.3020	3.323
	Eq 2	-12.5830	-3.501
37	Eq 1	-0.4392	-4.087

3.5.2 C.I.S.

3.5.2.1 Russia

Adjustment Vectors and t-Statistics - Russia			
Product Category	Cointegrating Equation	Adjustment Vector	t-Statistic
1B	Eq 1	-870.0803	-1.774
3	Eq 1	47.1342	1.845
	Eq 2	1.1141	0.590
4	Eq 1	-67.2520	-2.370
6A	Eq 1	86.4984	1.797
	Eq 2	0.1457	0.996
6B	Eq 1	-1,177.1570	-2.623
14	Eq 1	-41.9469	-1.275
	Eq 2	0.0813	0.421
15	Eq 1	-68.5937	-3.439
16	Eq 1	-138.4103	-1.215
	Eq 2	-14.1280	-6.109
17	Eq 1	-17.4675	-3.776
18	Eq 1	-14.7894	-1.841
	Eq 2	0.6705	0.670
	Eq 3	-0.0019	-1.530
19	Eq 1	-20.9661	-0.337
	Eq 2	4.3957	2.637
	Eq 3	-0.0063	-2.851
20	Eq 1	-18.2870	-3.956
21A	Eq 1	20.4884	3.034
	Eq 2	-1.0602	-4.726

Adjustment Vectors and t-Statistics - Russia (continued)			
Product Category	Cointegrating Equation	Adjustment Vector	t-Statistic
23	Eq 1	-8.9024	-2.346
31	Eq 1	5.6641	0.044
32	Eq 1	-115.7993	-3.247
33A	Eq 1	-3.0116	-4.943
35	Eq 1	-20.2564	-1.446
	Eq 2	-0.1145	-3.767
37	Eq 1	-1.7574	-2.799

3.5.2.2 Ukraine

Adjustment Vectors and t-Statistics - Ukraine			
Product Category	Cointegrating Equation	Adjustment Vector	t-Statistic
1B	Eq 1	1,011.9280	3.275
3	Eq 1	-441.8830	-2.437
	Eq 2	-0.1352	-0.031
4	Eq 1	2.1500	1.260
6A	Eq 1	-341.9091	-0.417
6B	Eq 1	8.1479	1.780
14	Eq 1	42.1472	1.685
16	Eq 1	-55.4791	-3.259
17	Eq 1	-3.5142	-5.213
18	Eq 1	-3.2202	-0.757
21A	Eq 1	-2.4621	-0.880
21B	Eq 1	-8.5617	-4.564
21CD	Eq 1	-0.4702	-1.046
22A	Eq 1	-6.7354	-1.674
31	Eq 1	4.9848	0.459
32	Eq 1	17.7226	3.122

3.5.3 North America

3.5.3.1 Canada

Adjustment Vectors and t-Statistics - Canada			
Product Category	Cointegrating Equation	Adjustment Vector	t-Statistic
1A	Eq 1	18.5530	4.319
	Eq 2	-0.5887	-1.258
	Eq 3	0.0001	0.195
1B	Eq 1	-1,260.4030	-0.919
	Eq 2	-1.4151	-2.079
3	Eq 1	215.8064	0.892
	Eq 2	1.0455	1.854
	Eq 3	-0.0021	-2.249
	Eq 4	-110,081.7000	-2.815
4	Eq 1	12.6642	0.217
	Eq 2	0.2511	1.101
5	Eq 1	-14.1383	-2.369
	Eq 2	-0.3046	-0.548
6A	Eq 1	69.3814	1.127
	Eq 2	-0.2138	-1.878
	Eq 3	-0.0002	-1.443
6B	Eq 1	66.8928	1.357
	Eq 2	-0.4744	-1.856
7	Eq 1	3.0711	2.938
8	Eq 1	32.4213	3.342
9	Eq 1	-9.6485	-2.956
14	Eq 1	-135.1036	-0.412
	Eq 2	-1.3295	-1.643
	Eq 3	0.0002	0.402
	Eq 4	27,556.9300	0.761
14A	Eq 1	86.1145	0.851
	Eq 2	-3.1473	-3.537
15	Eq 1	-8.5655	-0.640
	Eq 2	2.3217	3.290
16	Eq 1	16.4260	2.153
	Eq 2	-0.0196	-0.414
17	Eq 1	1.0544	0.432
18	Eq 1	138.9118	2.545
	Eq 2	0.3647	3.515
19	Eq 1	116.7585	1.444
	Eq 2	-0.6396	-1.634
	Eq 3	0.0001	0.581
20	Eq 1	-219.4312	-2.562
	Eq 2	-0.6933	-3.510

Adjustment Vectors and t-Statistics - Canada (continued)			
Product Category	Cointegrating Equation	Adjustment Vector	t-Statistic
21A	Eq 1	3.7718	1.312
21B	Eq 1	21.4536	2.191
	Eq 2	-1.2964	-2.489
21CD	Eq 1	2.4455	0.276
	Eq 2	0.0201	0.065
	Eq 3	0.0000	-0.973
21E	Eq 1	15.8355	1.556
	Eq 2	-0.7329	-1.629
	Eq 3	0.0004	0.906
22A	Eq 1	-152.7282	-1.673
	Eq 2	-0.4292	-1.939
	Eq 3	-0.0004	-2.340
22B	Eq 1	-56.9862	-2.436
28	Eq 1	4.5512	1.833
	Eq 2	-1.5735	-2.600
29	Eq 1	-10.8290	-0.436
	Eq 2	-0.2961	-1.728
29A	Eq 1	-21.2201	-3.368
31	Eq 1	-55.0231	-0.453
	Eq 2	0.0701	0.424
32	Eq 1	-284.6262	-3.391
	Eq 2	-0.5451	-0.694
	Eq 3	-0.0012	-1.219
33A	Eq 1	-170.5949	-1.316
	Eq 2	-0.9115	-1.567
	Eq 3	0.0007	0.817
33B	Eq 1	4.1442	0.747
	Eq 2	-0.7278	-1.061
34	Eq 1	57.3098	3.015
35	Eq 1	0.3177	0.875
36	Eq 1	12.7399	4.161
37	Eq 1	-0.6122	-0.142

3.5.3.2 Mexico

Adjustment Vectors and t-Statistics - Mexico			
Product Category	Cointegrating Equation	Adjustment Vector	t-Statistic
1A	Eq 1	17.2500	1.179
	Eq 2	-0.4332	-0.767
	Eq 3	0.0001	0.149
	Eq 4	774.6879	3.381
1B	Eq 1	-951.8549	-3.002
3	Eq 1	151.4516	0.325
	Eq 2	4.5191	1.360
	Eq 3	4.5191	-1.571
	Eq 4	19,457.8900	1.897
4	Eq 1	-2.2302	-0.049
	Eq 2	-0.7870	-1.045
	Eq 3	0.0011	1.156
6A	Eq 1	0.0841	0.108
6B	Eq 1	-29.0763	-1.451
8	Eq 1	0.0748	1.108
9	Eq 1	1.1683	0.708
14	Eq 1	2.0058	1.333
14A	Eq 1	-63.2158	-1.186
	Eq 2	-3.8836	-1.538
15	Eq 1	-52.5583	-0.307
	Eq 2	-0.5279	-1.763
	Eq 3	0.0005	0.793
16	Eq 1	-0.0117	-0.047
17	Eq 1	-0.7587	-28.186
18	Eq 1	-2.3630	-0.184
20	Eq 1	357.8468	2.287
21A	Eq 1	-2.3414	-0.424
	Eq 2	-0.4243	-3.429
21B	Eq 1	-11.0456	-1.175
21CD	Eq 1	-0.1830	-1.837
21E	Eq 1	-2.1878	-2.803
22A	Eq 1	-6.3977	-1.008
	Eq 2	-0.1758	-1.022
	Eq 3	-0.0003	-1.925
22B	Eq 1	-0.7010	-6.051
23	Eq 1	-26.5309	-2.035
	Eq 2	0.3376	1.766

Adjustment Vectors and t-Statistics - Mexico (continued)			
Product Category	Cointegrating Equation	Adjustment Vector	t-Statistic
28	Eq 1	1.9431	1.454
29	Eq 1	-0.5800	-1.816
31	Eq 1	156.0388	2.787
32	Eq 1	-79.1706	-3.734
33A	Eq 1	79.0256	2.517
33B	Eq 1	3.6425	1.426
34	Eq 1	-27.1493	-2.962
35	Eq 1	13.3448	2.970
	Eq 2	-10.3389	-3.334
36	Eq 1	-3.7695	-4.455
37	Eq 1	9.4201	0.447
	Eq 2	-0.4121	-1.412

3.5.4 South America (Brazil)

Adjustment Vectors and t-Statistics - Brazil			
Product Category	Cointegrating Equation	Adjustment Vector	t-Statistic
1A	Eq 1	47.5136	5.238
1B	Eq 1	-2,988.3420	-3.627
3	Eq 1	567.3887	0.811
4	Eq 1	866.9753	3.233
6A	Eq 1	-39.5277	-1.104
6B	Eq 1	25.3412	1.988
9	Eq 1	-1.1362	-2.065
	Eq 2	2.9536	3.510
14	Eq 1	367.8156	2.761
	Eq 2	-3.8777	-3.734
14A	Eq 1	485.6935	3.823
15	Eq 1	75.3971	1.968
16	Eq 1	0.8316	0.680
17	Eq 1	-1.2344	-0.124
	Eq 2	-1.5021	-1.973
18	Eq 1	7.2614	1.645
19	Eq 1	70.0441	0.581
	Eq 2	0.5402	0.663

Adjustment Vectors and t-Statistics - Brazil (continued)			
Product Category	Cointegrating Equation	Adjustment Vector	t-Statistic
20	Eq 1	110.9440	2.142
21A	Eq 1	71.5317	4.084
21B	Eq 1	0.8732	0.271
	Eq 2	0.1031	0.267
21CD	Eq 1	2.0782	4.048
21E	Eq 1	0.1443	6.080
22A	Eq 1	4.1567	7.097
23	Eq 1	17.1601	3.266
28	Eq 1	17.1353	1.244
29	Eq 1	96.4940	1.049
29A	Eq 1	-0.5079	-0.305
31	Eq 1	0.5874	0.322
33A	Eq 1	85.2750	0.929
33B	Eq 1	15.7913	2.556
34	Eq 1	-3.8015	-0.019
	Eq 2	4.4837	3.644
	Eq 3	-0.0087	-4.301
	Eq 4	-3,799.4270	-1.716
35	Eq 1	-0.2619	-0.823
	Eq 2	-0.7202	-1.403
36	Eq 1	21.6681	1.072
37	Eq 1	4.9424	2.853

3.5.5 Africa (South Africa)

Adjustment Vectors and t-Statistics - South Africa			
Product Category	Cointegrating Equation	Adjustment Vector	t-Statistic
1B	Eq 1	-302.1242	-3.677
3	Eq 1	-94.3082	-3.157
4	Eq 1	103.2539	1.318
	Eq 2	-4.0479	-1.746
	Eq 3	0.0119	1.713
6A	Eq 1	-15.7500	-1.005
	Eq 2	-1.0737	-4.913
6B	Eq 1	-1.6836	-0.849
	Eq 2	0.2977	0.509

Adjustment Vectors and t-Statistics - South Africa (continued)			
Product Category	Cointegrating Equation	Adjustment Vector	t-Statistic
14	Eq 1	21.9077	3.480
16	Eq 1	-4.1973	-5.271
18	Eq 1	-0.1185	-3.758
19	Eq 1	-30.8984	-2.286
20	Eq 1	10.1497	0.823
21A	Eq 1	-12.6580	-4.968
21CD	Eq 1	-0.2137	-0.392
21E	Eq 1	0.4679	1.645
22A	Eq 1	2.6574	4.219
22B	Eq 1	0.6440	3.403
23	Eq 1	-60.6351	-3.170
31	Eq 1	-144.2083	-2.389
32	Eq 1	-336.4327	-2.420
33A	Eq 1	42.4869	2.138
37	Eq 1	-1.5186	-3.620
	Eq 2	1.4244	1.281

3.5.6 Middle East (Turkey)

Adjustment Vectors and t-Statistics - Turkey			
Product Category	Cointegrating Equation	Adjustment Vector	t-Statistic
1B	Eq 1	-50.5985	-0.132
3	Eq 1	-62.3275	-3.449
4	Eq 1	-46.7491	-2.927
6A	Eq 1	-19.4571	-1.771
6B	Eq 1	266.0030	3.348
14	Eq 1	-2.8693	-0.102
	Eq 2	-0.6211	-2.768
14A	Eq 1	-9.6861	-3.765
15	Eq 1	2,220.5520	2.843
16	Eq 1	1.6864	2.211
17	Eq 1	1.5882	3.572
18	Eq 1	124.2145	0.657
	Eq 2	-4.0601	-1.717
	Eq 3	0.0018	0.532
19	Eq 1	4.5297	0.719

Adjustment Vectors and t-Statistics - Turkey (continued)			
Product Category	Cointegrating Equation	Adjustment Vector	t-Statistic
21A	Eq 1	101.0343	2.947
	Eq 2	-1.3660	-2.755
	Eq 3	0.0017	1.946
21B	Eq 1	0.0315	2.875
21CD	Eq 1	0.2273	3.668
22A	Eq 1	8.1150	2.003
23	Eq 1	-8.0408	-2.481
31	Eq 1	-241.0992	-2.716
32	Eq 1	466.3003	0.937
33A	Eq 1	-56.4650	-4.633
36	Eq 1	-7.7773	-2.896
37	Eq 1	-0.0374	-6.098

3.5.7 Asia

3.5.7.1 China

Adjustment Vectors and t-Statistics - China			
Product Category	Cointegrating Equation	Adjustment Vector	t-Statistic
1A	Eq 1	-0.0632	-0.327
1B	Eq 1	-215.5361	-3.803
3	Eq 1	43.8405	0.105
	Eq 2	0.1633	0.789
4	Eq 1	118.9676	1.068
	Eq 2	-1.3151	-1.938
	Eq 3	0.0019	1.369
5	Eq 1	-0.2771	-4.484
6A	Eq 1	-71.0275	-0.404
6B	Eq 1	-14.9362	-0.570
	Eq 2	0.0790	0.633
7	Eq 1	19.7008	2.195
	Eq 2	-49.6390	-4.301
	Eq 3	0.0843	4.221
8	Eq 1	-54.4801	-0.704
	Eq 2	-28.7753	-0.942
9	Eq 1	-2.7528	-2.644
	Eq 2	1.0951	1.450

Adjustment Vectors and t-Statistics - China (continued)			
Product Category	Cointegrating Equation	Adjustment Vector	t-Statistic
14A	Eq 1	13.5042	1.484
	Eq 2	-1.9950	-2.611
	Eq 3	0.0034	2.021
15	Eq 1	-231.4835	-3.268
16	Eq 1	55.5688	-0.001
	Eq 2	-0.1117	-0.698
	Eq 3	-0.0007	-3.389
17	Eq 1	-2.0781	-0.478
18	Eq 1	-179.8287	-1.141
20	Eq 1	188.9131	1.864
	Eq 2	-0.4869	-0.591
	Eq 3	0.0003	0.284
21A	Eq 1	30.5679	1.605
21B	Eq 1	30.3159	2.749
	Eq 2	1.4128	2.043
	Eq 3	-0.0016	-2.263
	Eq 4	1,024.7680	1.272
21CD	Eq 1	-2.3730	-0.416
	Eq 2	0.1622	0.829
	Eq 3	-0.0001	-2.075
21E	Eq 1	0.9974	1.702
22A	Eq 1	413.6686	4.247
	Eq 2	16.2758	4.023
	Eq 3	-0.0296	-4.139
	Eq 4	13,620.7300	2.145
22B	Eq 1	3.9460	0.544
	Eq 2	2.6026	1.606
23	Eq 1	-76.9095	-0.827
	Eq 2	2.1422	3.310
28	Eq 1	5.1819	1.652
29	Eq 1	30.6245	2.037
	Eq 2	0.2488	0.242
	Eq 3	-0.0010	-0.616
31	Eq 1	162.3708	2.074
32	Eq 1	42.8273	0.329
	Eq 2	0.1007	0.818
33A	Eq 1	213.0015	1.439
	Eq 2	1.6039	4.994
33B	Eq 1	9.3118	0.962
	Eq 2	0.2987	0.634
35	Eq 1	6.3703	2.170
36	Eq 1	3.5176	2.208
37	Eq 1	17.1126	4.205
	Eq 2	0.4832	2.729

3.5.7.2 Japan

Adjustment Vectors and t-Statistics - Japan			
Product Category	Cointegrating Equation	Adjustment Vector	t-Statistic
1A	Eq 1	-3.8867	-1.874
	Eq 2	-1.4391	-2.147
	Eq 3	0.0026	1.905
1B	Eq 1	1,701.6040	1.076
	Eq 2	2.4391	1.594
	Eq 3	-0.0101	-1.844
3	Eq 1	17.2922	0.672
	Eq 2	-1.2341	-3.301
4	Eq 1	-1.0796	-0.481
5	Eq 1	11.1845	4.039
6A	Eq 1	29.3814	0.644
	Eq 2	-0.0768	-0.383
7	Eq 1	314.6894	1.242
	Eq 2	1.4667	1.126
8	Eq 1	-9.1263	-0.645
14	Eq 1	45.3955	2.757
14A	Eq 1	43.7211	2.059
	Eq 2	2.4619	1.879
15	Eq 1	223.9930	1.551
16	Eq 1	-7.6715	-3.046
17	Eq 1	0.5184	0.009
	Eq 2	-0.7127	-1.379
	Eq 3	-0.0005	-0.756
18	Eq 1	-126.8452	-2.136
19	Eq 1	52.3346	3.389
	Eq 2	-0.0662	-0.517
20	Eq 1	168.8079	3.249
21A	Eq 1	-24.3968	-1.294
	Eq 2	-1.6839	-2.698
21B	Eq 1	1.4163	4.726
21CD	Eq 1	77.5887	1.187
	Eq 2	0.1556	0.086
	Eq 3	-0.0006	-1.326
21E	Eq 1	7.7054	2.555
	Eq 2	-1.4364	-3.430
22A	Eq 1	9.1360	4.723
22B	Eq 1	5.4221	2.977

Adjustment Vectors and t-Statistics - Japan (continued)			
Product Category	Cointegrating Equation	Adjustment Vector	t-Statistic
23	Eq 1	-27.6034	-0.719
	Eq 2	-0.7396	-2.074
	Eq 3	0.0003	0.474
28	Eq 1	-15.1934	-0.099
	Eq 2	-3.9333	-1.838
	Eq 3	0.0043	1.090
	Eq 4	-139.5073	-1.002
29	Eq 1	132.7689	6.185
29A	Eq 1	-23.4042	-0.470
	Eq 2	-2.0030	-1.575
	Eq 3	0.0029	1.319
	Eq 4	-97.9244	-1.809
31	Eq 1	18.4162	0.631
32	Eq 1	88.0895	2.780
33A	Eq 1	49.5052	2.425
33B	Eq 1	63.0363	2.612
	Eq 2	-1.0582	-2.186
34	Eq 1	-5.7816	-0.572
	Eq 2	0.7840	0.805
35	Eq 1	-24.6609	-1.747
	Eq 2	-2.2179	-4.021
	Eq 3	0.0026	3.838
36	Eq 1	0.0364	0.127
37	Eq 1	-4.5835	-3.495

3.5.7.3 South Korea

Adjustment Vectors and t-Statistics - South Korea			
Product Category	Cointegrating Equation	Adjustment Vector	t-Statistic
1B	Eq 1	4.3539	4.655
3	Eq 1	-12.3527	-1.650
	Eq 2	-1.3434	-2.460
	Eq 3	0.0008	2.848
4	Eq 1	0.9599	0.944
6A	Eq 1	37.6079	0.980
6B	Eq 1	-5.9797	-1.432

Adjustment Vectors and t-Statistics - South Korea (continued)			
Product Category	Cointegrating Equation	Adjustment Vector	t-Statistic
7	Eq 1	1.1292	1.813
	Eq 2	8.8967	5.706
	Eq 3	-0.0328	-6.236
8	Eq 1	-0.0008	-2.419
14	Eq 1	31.3675	1.577
14A	Eq 1	25.0428	3.790
	Eq 2	-1.3912	-4.055
16	Eq 1	1.4514	0.194
	Eq 2	-2.7514	-0.818
	Eq 3	0.0018	0.788
18	Eq 1	11.2056	2.676
19	Eq 1	-128.8393	-1.956
	Eq 2	-51.6108	-1.784
	Eq 3	0.1264	1.794
20	Eq 1	7.3421	0.311
21A	Eq 1	5.3778	0.588
	Eq 2	-1.4264	-0.874
21B	Eq 1	-0.0693	-0.068
	Eq 2	-0.0164	-0.052
21CD	Eq 1	-1.2650	-0.206
21E	Eq 1	0.1348	5.564
22A	Eq 1	-71.1265	-2.505
	Eq 2	-1.2921	-0.363
22B	Eq 1	-3.9737	-3.227
23	Eq 1	3.0596	1.733
29	Eq 1	9.5023	3.843
31	Eq 1	-154.3409	-0.723
	Eq 2	17.5448	2.521
	Eq 3	-0.0669	-2.533
32	Eq 1	-107.3425	-3.915
33A	Eq 1	-42.0587	-0.682
	Eq 2	-2.7890	-0.368
	Eq 3	0.0024	0.167
	Eq 4	-6.2496	-0.556
33B	Eq 1	5.3119	0.344
	Eq 2	2.5548	0.991
	Eq 3	-0.0059	-1.102
	Eq 4	-0.8080	-0.266
34	Eq 1	-38.7010	-2.479
	Eq 2	0.9508	0.561
35	Eq 1	-6.9760	-3.209
36	Eq 1	-0.5003	-3.563
37	Eq 1	3.0044	0.594
	Eq 2	0.5092	0.892

3.5.7.4 Taiwan

Adjustment Vectors and t-Statistics - Taiwan			
Product Category	Cointegrating Equation	Adjustment Vector	t-Statistic
1A	Eq 1	0.1713	1.223
1B	Eq 1	1.0255	2.510
3	Eq 1	-11.0431	-1.557
	Eq 2	-1.4373	-3.546
4	Eq 1	-24.3253	-2.613
	Eq 2	-69.2628	-3.232
6A	Eq 1	-5.2221	-1.302
	Eq 2	-0.0607	-0.375
6B	Eq 1	-33.3514	-2.955
7	Eq 1	-0.0010	-2.272
14	Eq 1	13.1505	1.640
	Eq 2	-3.1503	-3.911
14A	Eq 1	0.1933	4.774
16	Eq 1	-73.1805	-1.321
	Eq 2	-0.8362	-1.384
	Eq 3	0.0002	1.138
17	Eq 1	1.5417	1.107
	Eq 2	-1.1467	-0.671
	Eq 3	0.0003	0.311
	Eq 4	-22.6363	-1.993
18	Eq 1	-5.0939	-2.071
	Eq 2	-1.7044	-0.566
19	Eq 1	0.0747	2.616
	Eq 2	-1.7503	-3.939
20	Eq 1	-17.6457	-1.816
	Eq 2	5.0205	0.819
	Eq 3	-0.0152	-0.859
21A	Eq 1	0.3720	3.297
21CD	Eq 1	86.1643	3.143
	Eq 2	-0.4693	-0.749
	Eq 3	-0.0002	-1.290
21E	Eq 1	-0.0413	-1.466
22A	Eq 1	-0.0004	-0.827
23	Eq 1	2.7462	1.259
	Eq 2	-0.2889	-1.588
29	Eq 1	2.9247	6.327

Adjustment Vectors and t-Statistics - Taiwan (continued)			
Product Category	Cointegrating Equation	Adjustment Vector	t-Statistic
31	Eq 1	58.0696	-0.028
	Eq 2	7.1778	7.222
	Eq 3	-0.0277	-7.581
32	Eq 1	6.5234	0.212
33A	Eq 1	-37.8160	-1.655
	Eq 2	4.0925	1.516
33B	Eq 1	5.0828	0.655
	Eq 2	1.4265	2.460
34	Eq 1	-18.4947	-1.974
	Eq 2	0.1755	0.125
36	Eq 1	-1.2028	-0.931
	Eq 2	-1.3277	-2.766
37	Eq 1	-3.7096	-1.742
	Eq 2	0.5421	1.340

3.5.8 Oceania (Australia)

Adjustment Vectors and t-Statistics - Australia			
Product Category	Cointegrating Equation	Adjustment Vector	t-Statistic
1A	Eq 1	0.1564	1.094
	Eq 2	-0.2226	-0.833
1B	Eq 1	-856.6759	-1.353
4	Eq 1	0.5382	2.530
6A	Eq 1	43.6460	2.109
6B	Eq 1	3.5724	1.121
9	Eq 1	-15.1341	-5.965
14	Eq 1	-2.0447	-5.317
15	Eq 1	0.5316	0.946
16	Eq 1	0.1255	0.104
17	Eq 1	0.3753	3.065
18	Eq 1	0.6187	0.546
19	Eq 1	-0.0438	-1.161
21A	Eq 1	-3.2523	-3.467
	Eq 2	-0.0244	-0.133
21CD	Eq 1	-0.0335	-1.099
21E	Eq 1	-0.1122	-2.016
22A	Eq 1	-1.4049	-2.587

Adjustment Vectors and t-Statistics - Australia (continued)			
Product Category	Cointegrating Equation	Adjustment Vector	t-Statistic
23	Eq 1	9.4322	4.129
	Eq 2	-3.3741	-4.391
28	Eq 1	-26.7838	-0.704
29	Eq 1	-6.7758	-1.288
	Eq 2	-83.3336	-1.522
	Eq 3	0.1894	1.496
	Eq 4	1,356.1020	2.212
29A	Eq 1	0.0408	0.839
31	Eq 1	470.110	3.054
	Eq 2	-0.727	-3.541
32	Eq 1	-66.350	-1.828
34	Eq 1	0.0974	0.490
36	Eq 1	-0.3994	-0.770
37	Eq 1	2.0146	1.191
	Eq 2	-0.2310	-0.315
	Eq 3	-0.0002	-0.133

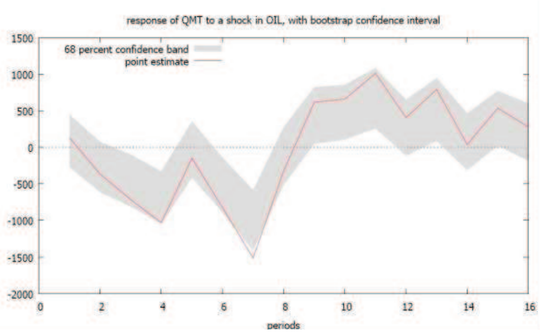
4 Graphical Display of Impulse Responses and Variance Decomposition

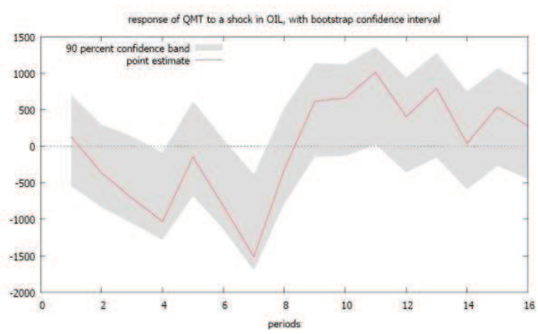
Section 4 contains graphical displays of the impulse response and variance decomposition estimates.

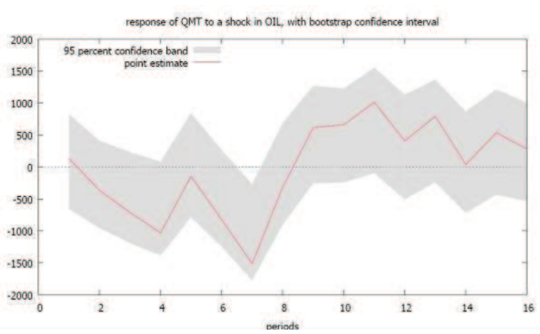
4.1 Steel Exporting Countries

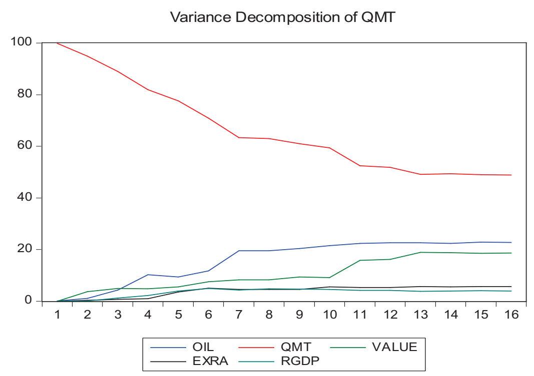
4.1.1 European Union

4.1.1.1 Austria









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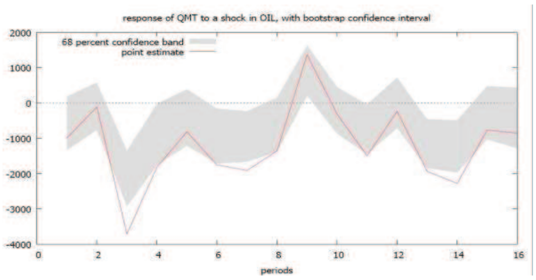
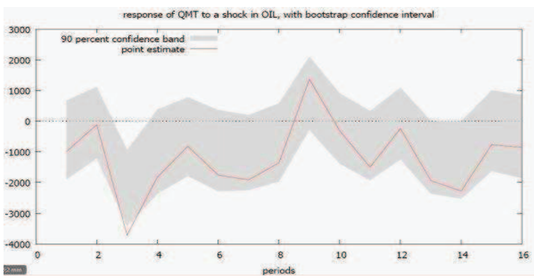
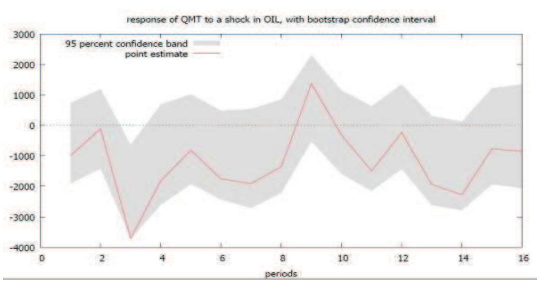
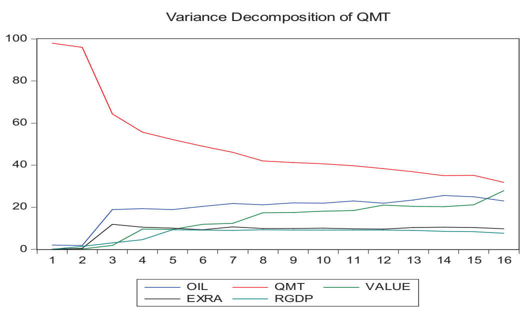
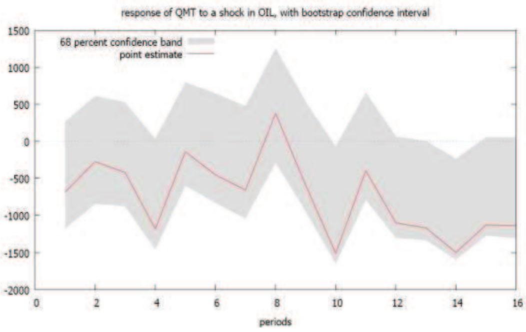


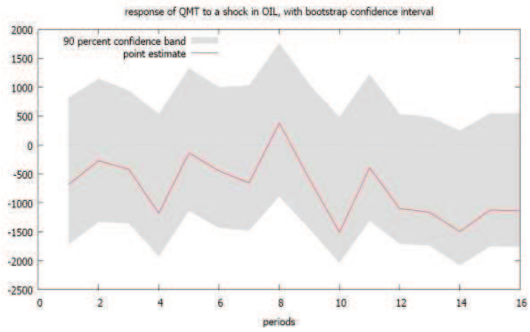


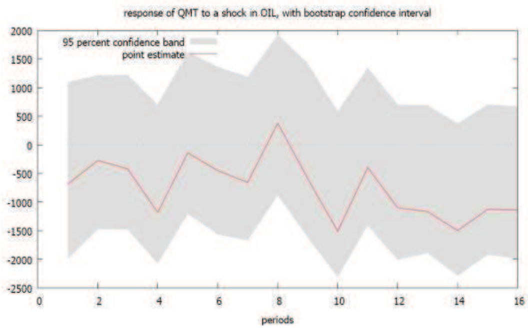


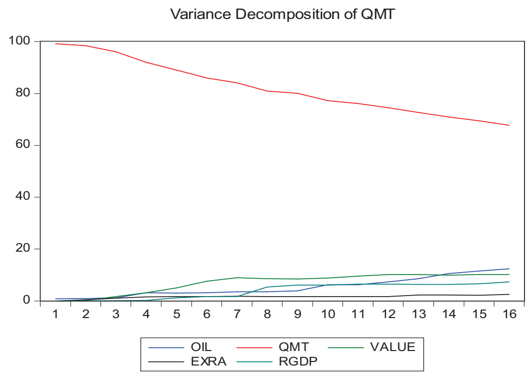


4.1.1.3 Bulgaria

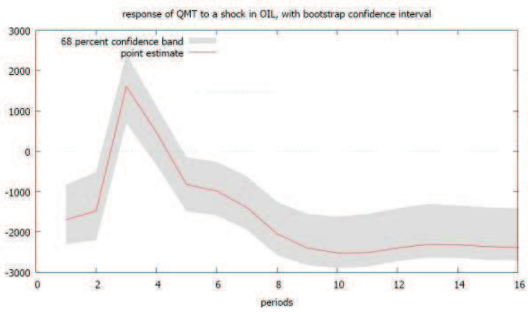


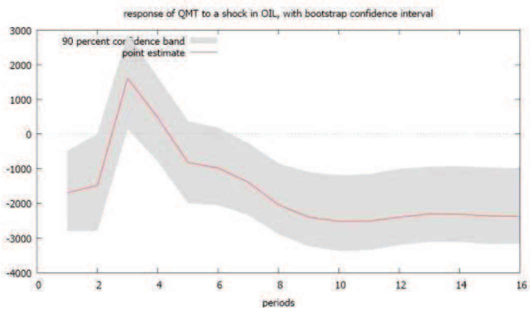


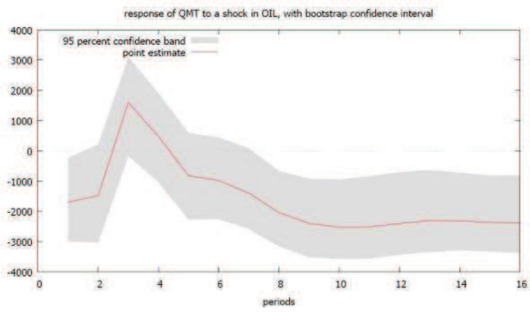


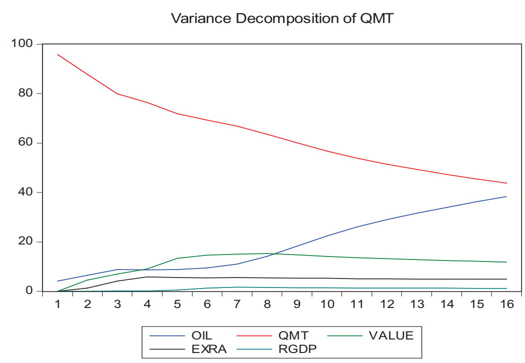


4.1.1.4 Czech Republic









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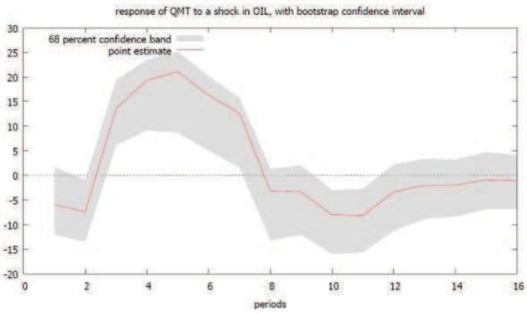
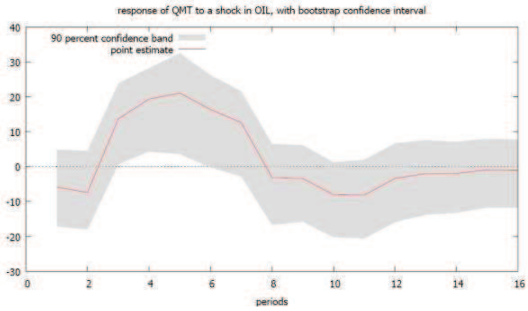
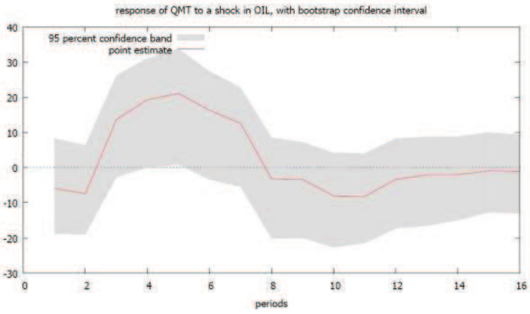
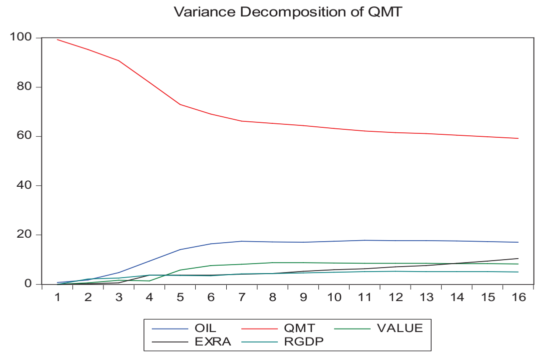
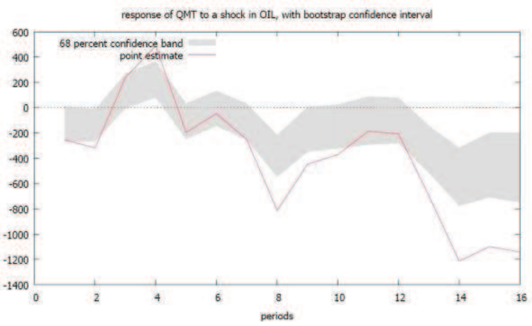


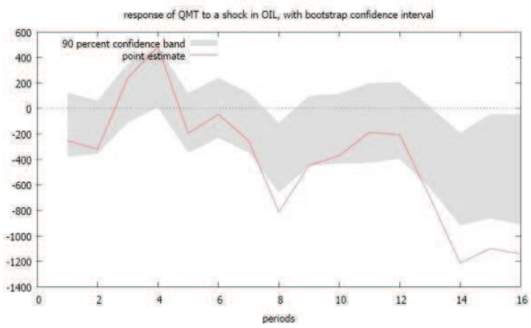


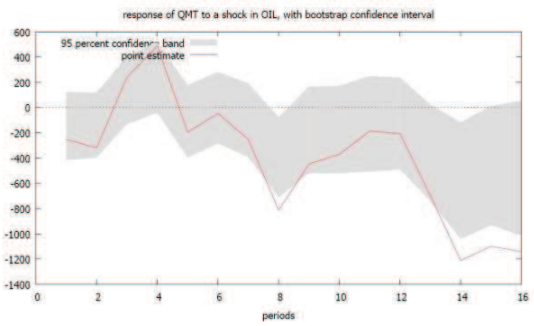


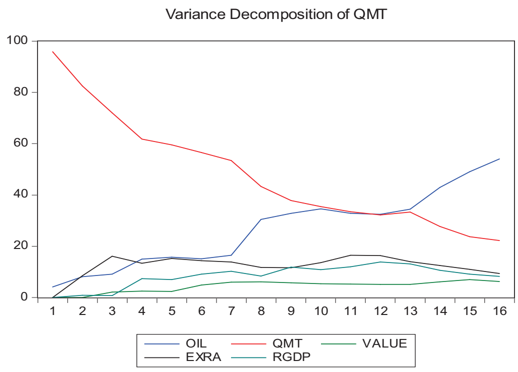


4.1.1.6 Estonia

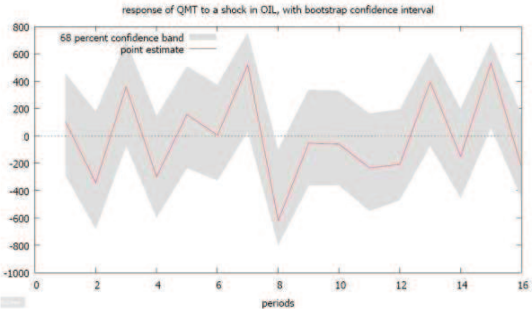


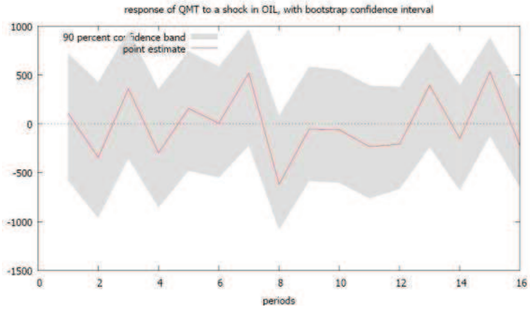


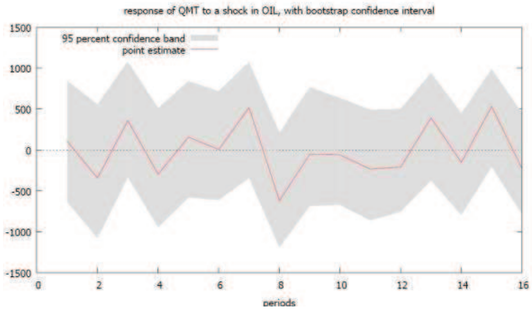


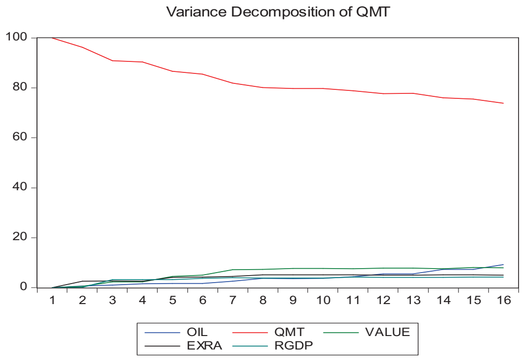


4.1.1.7 Finland

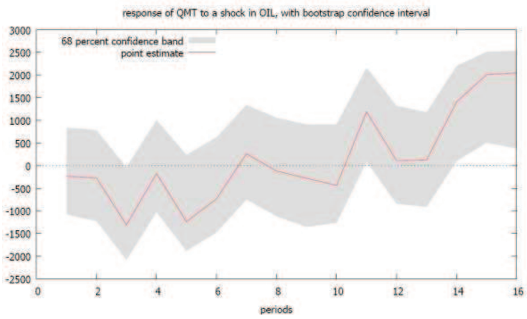


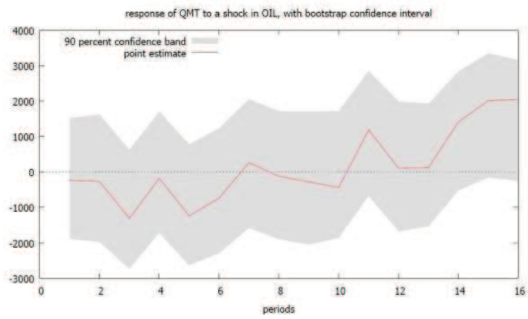


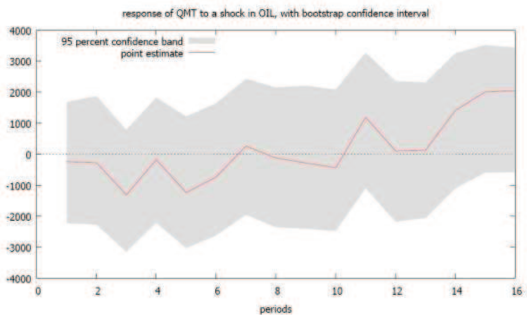


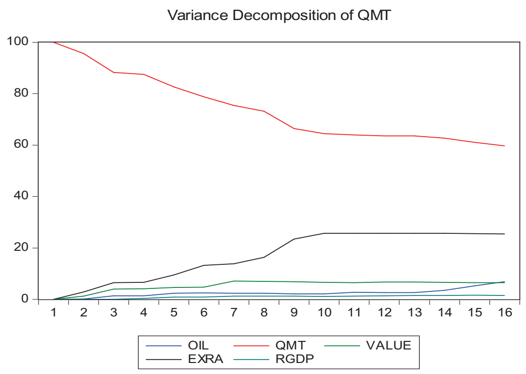


4.1.1.8 France

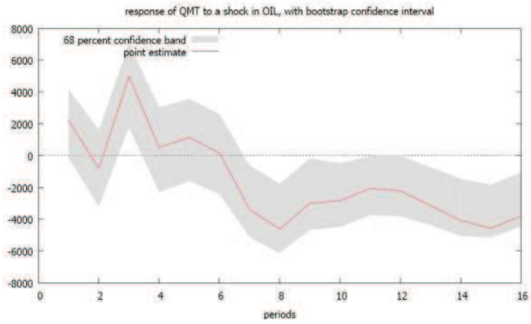


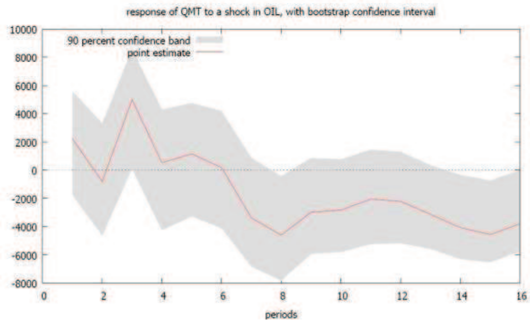


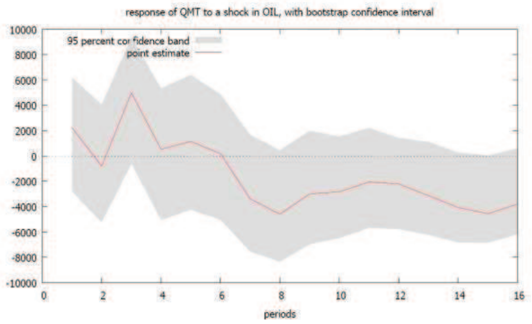


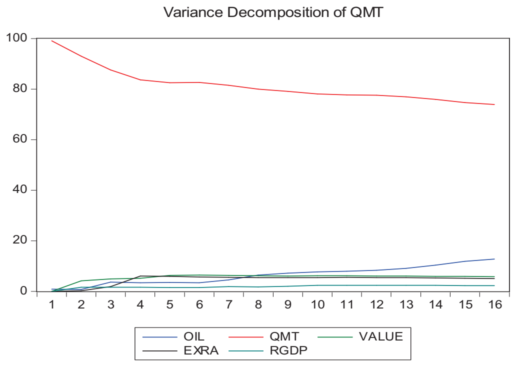


4.1.1.9 Germany

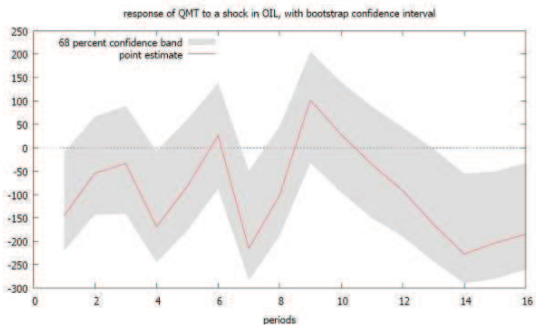


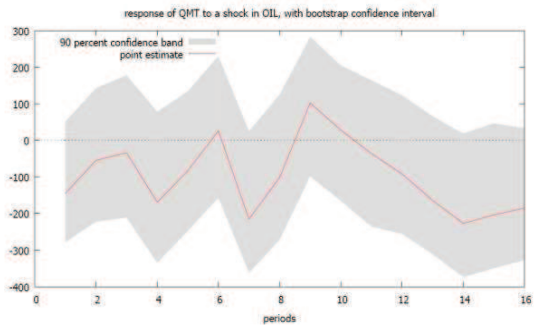


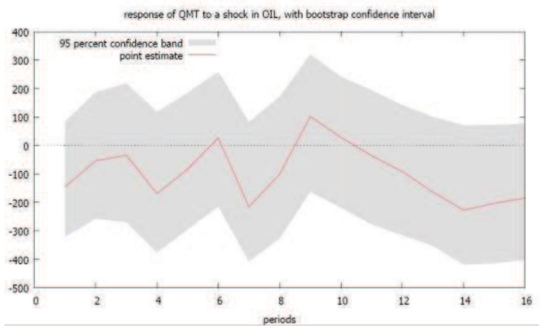


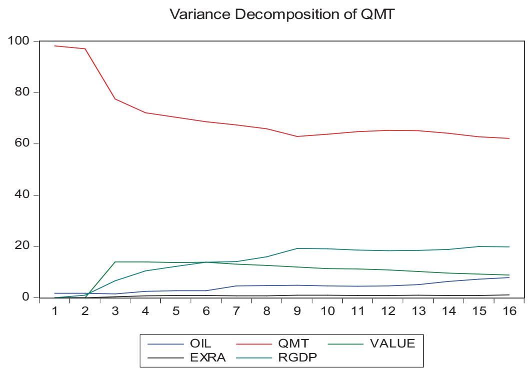


4.1.1.10 Hungary

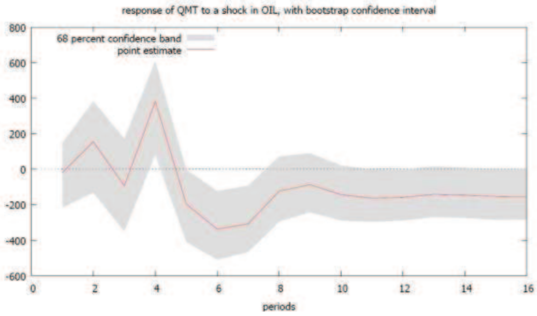


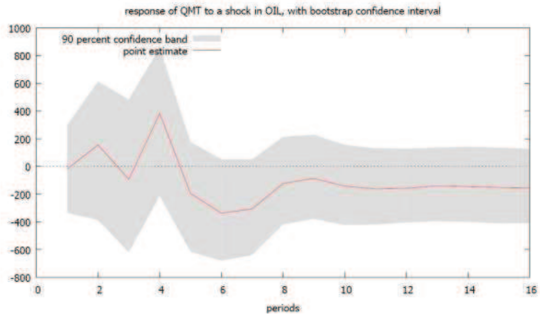


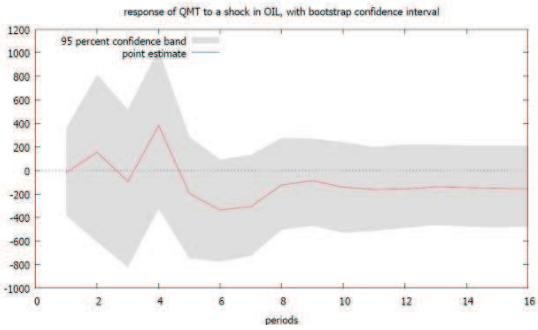


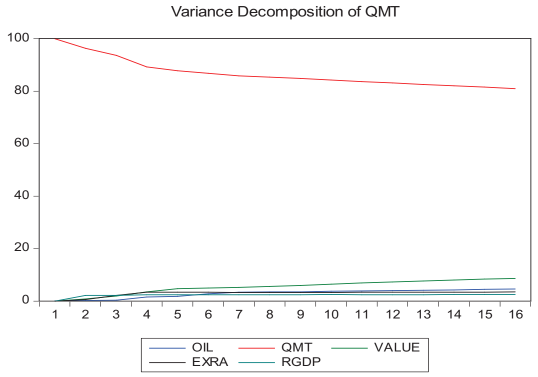


4.1.1.11 Ireland

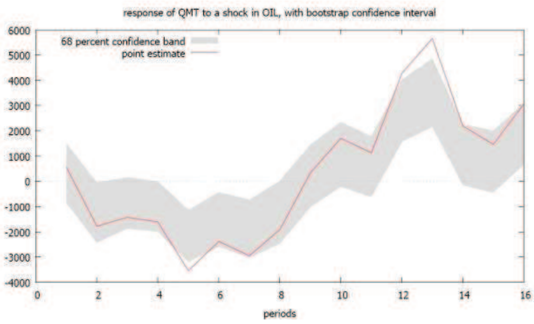


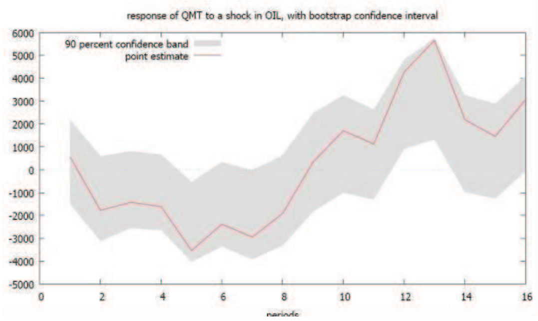


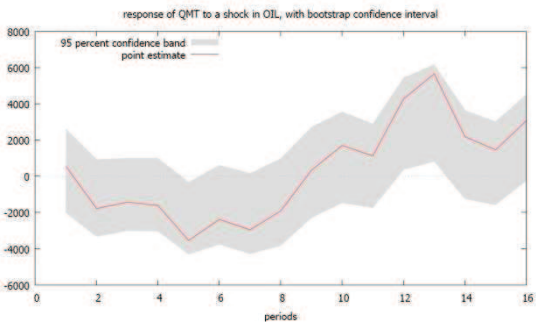


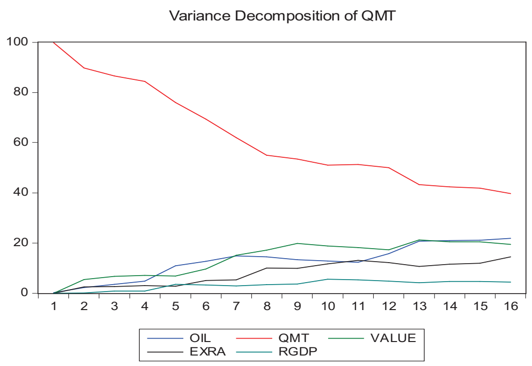


4.1.1.12 Italy

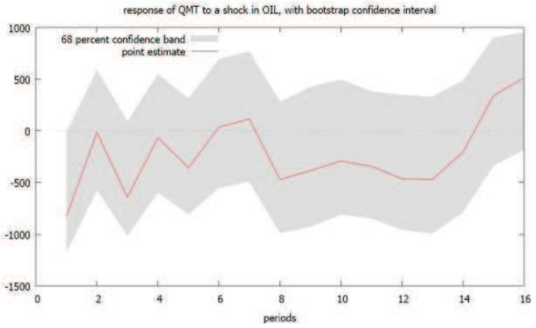


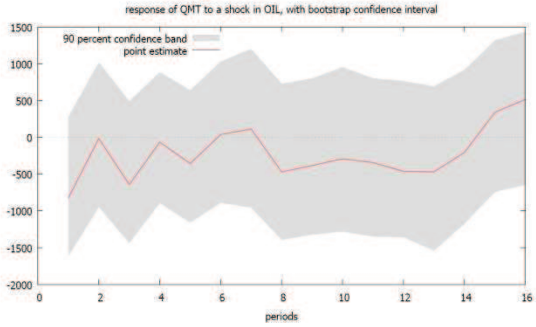


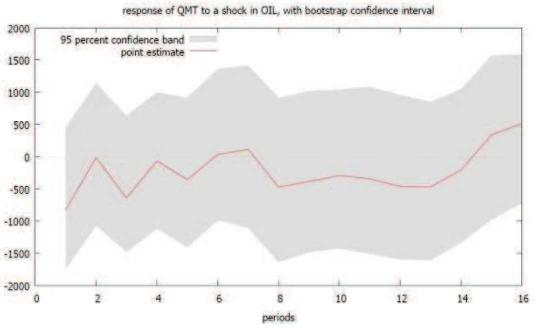


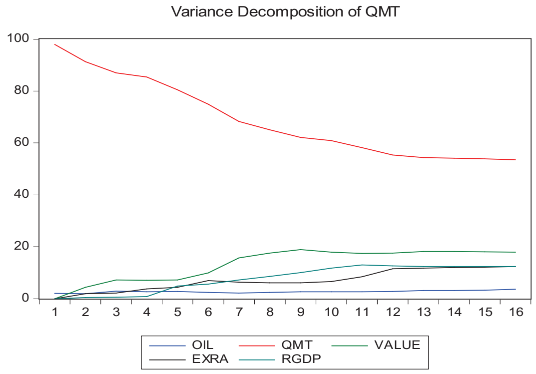


4.1.1.13 Latvia

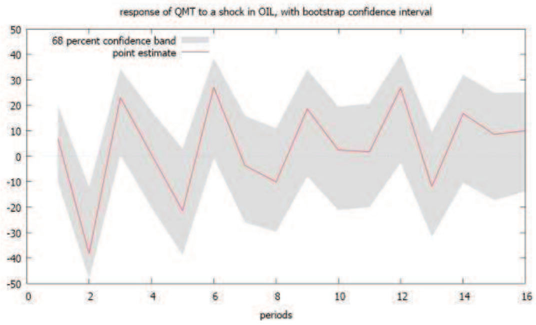


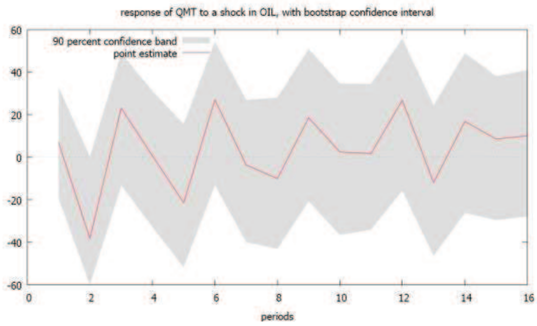


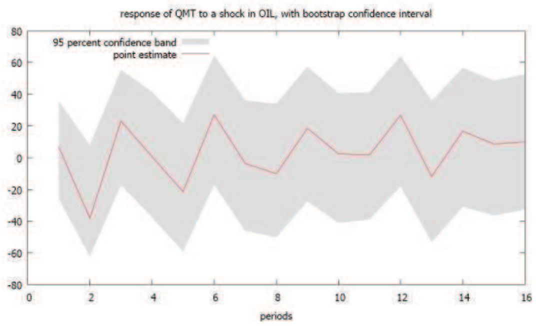


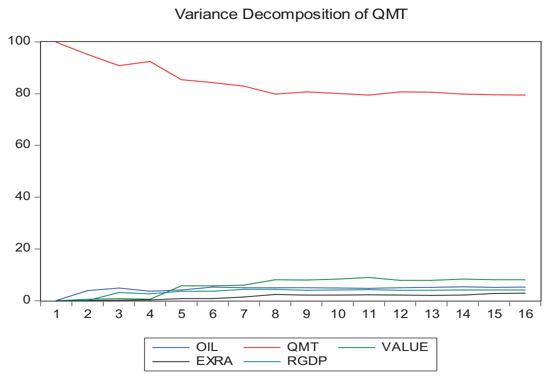


4.1.1.14 Lithuania









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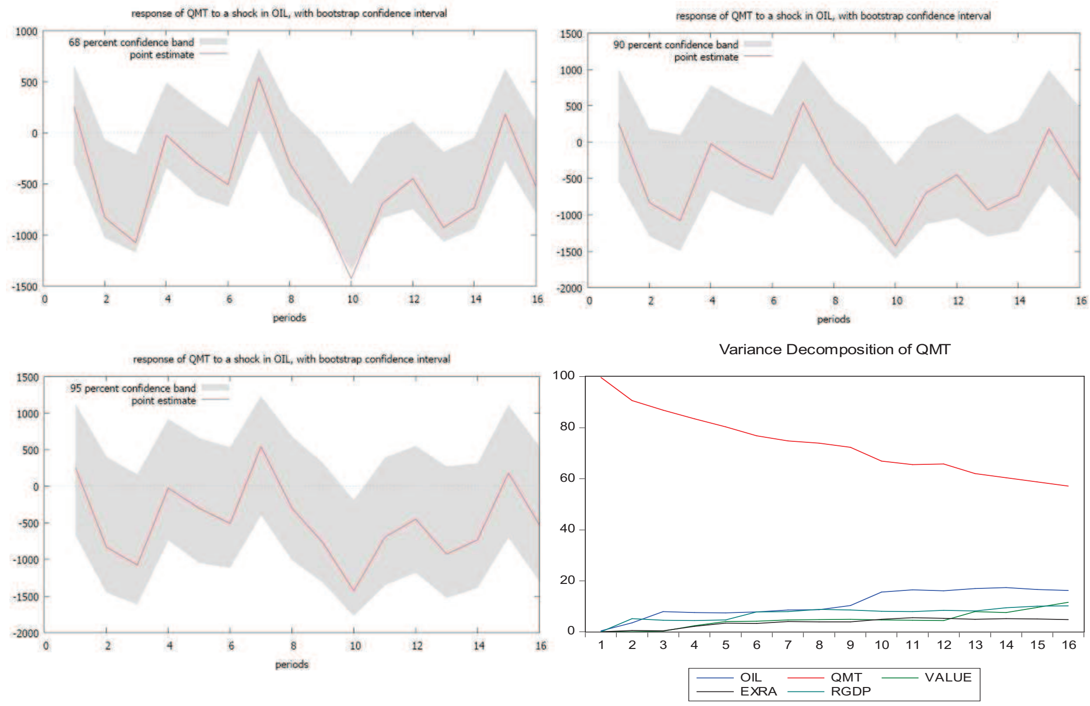

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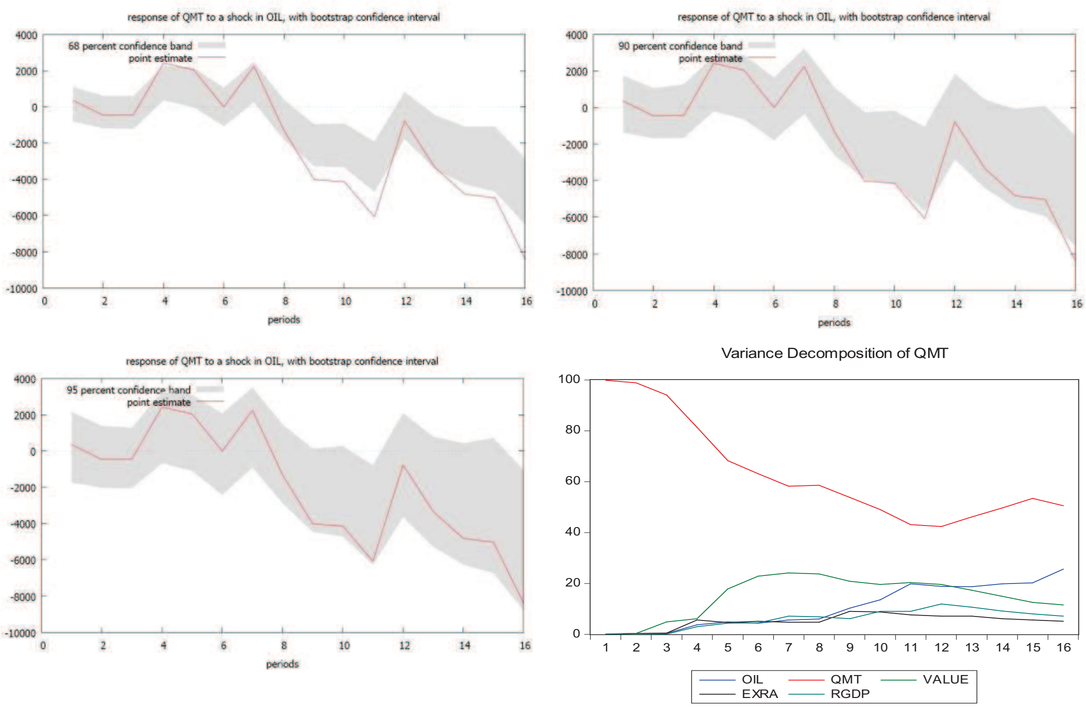
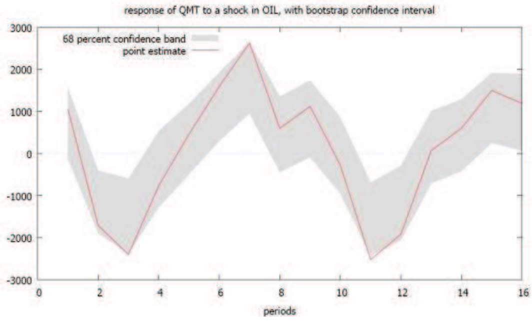
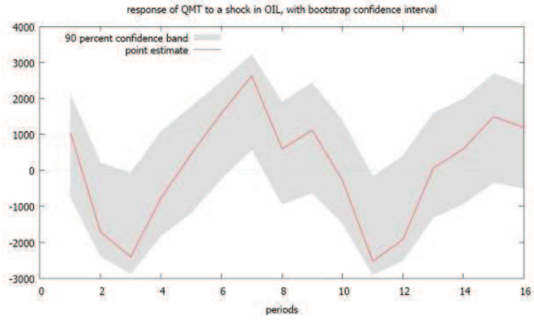
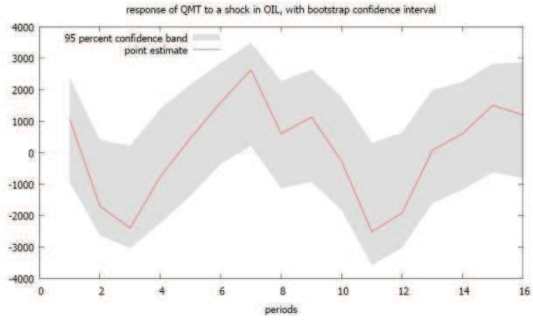
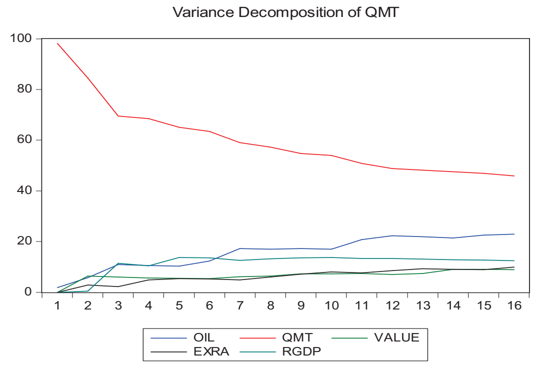


4.1.1.17 Poland









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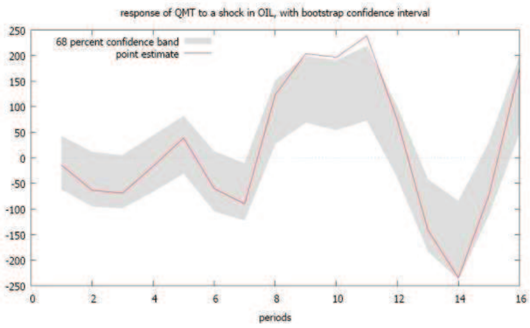

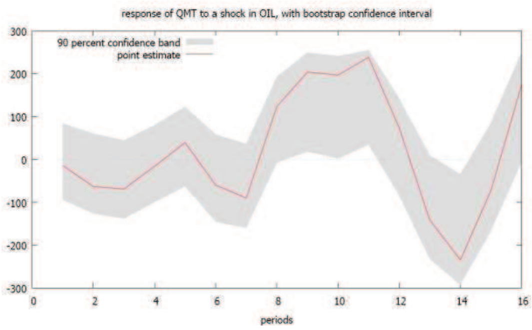

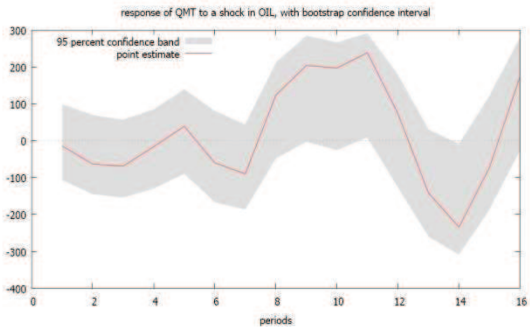

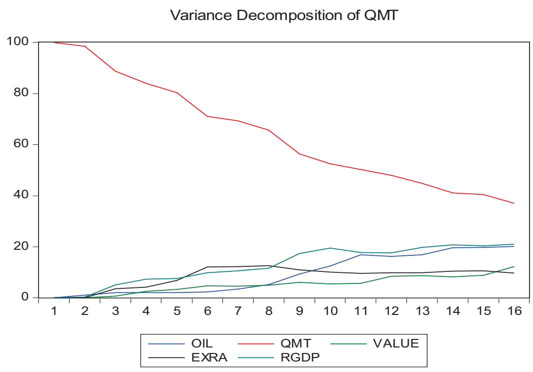

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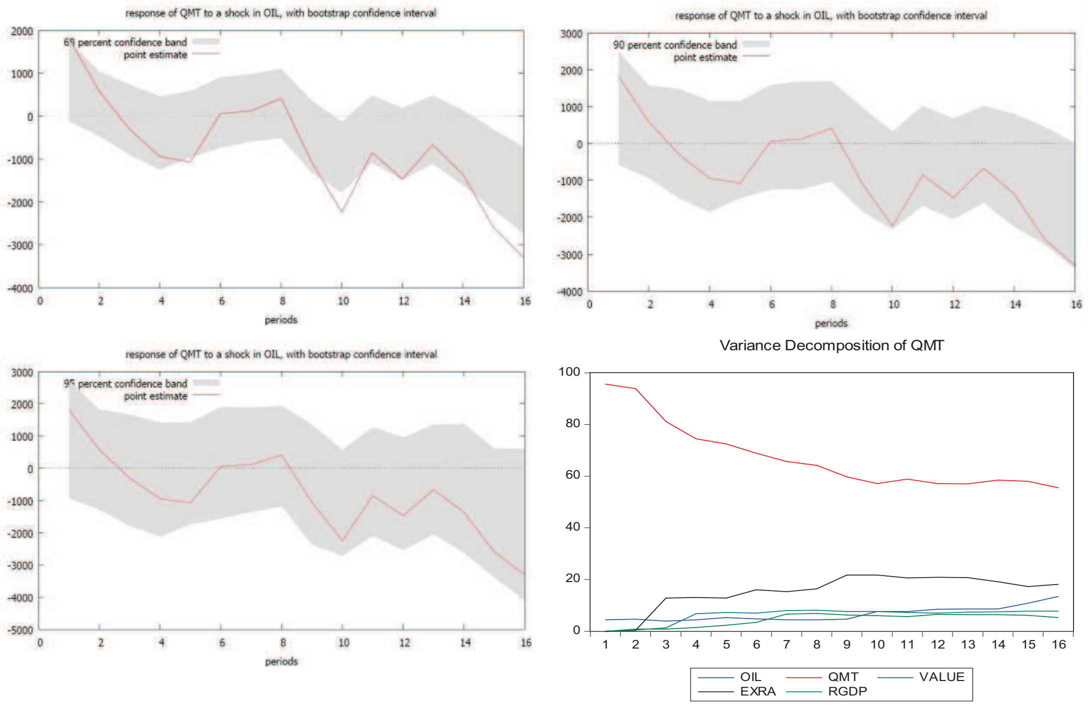

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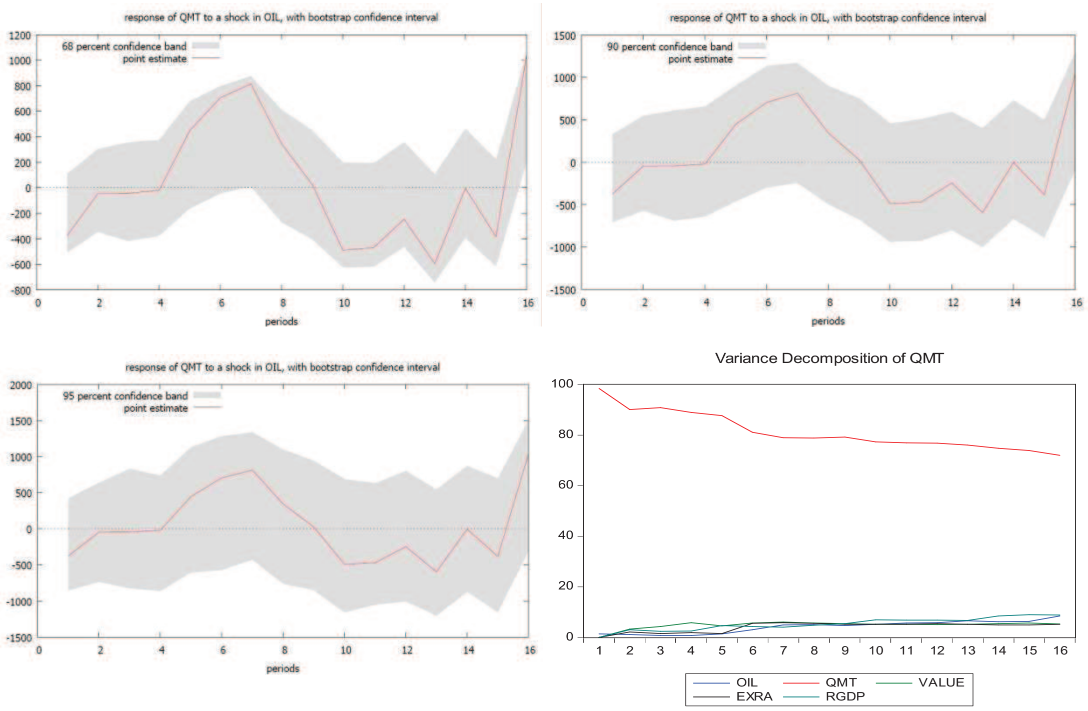

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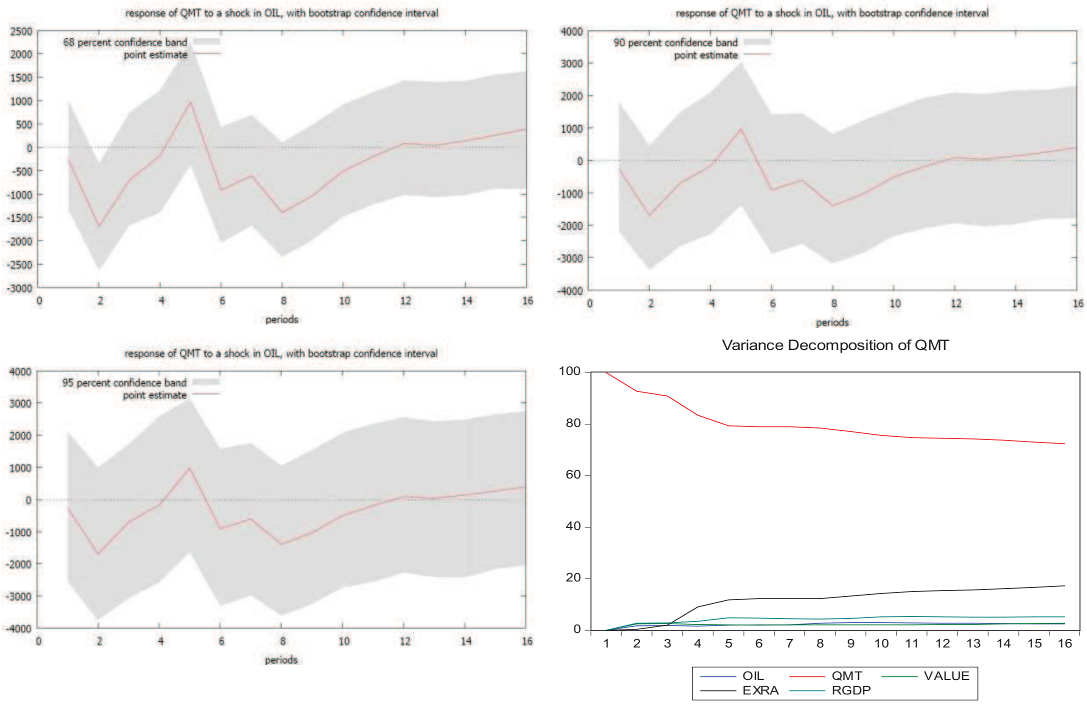
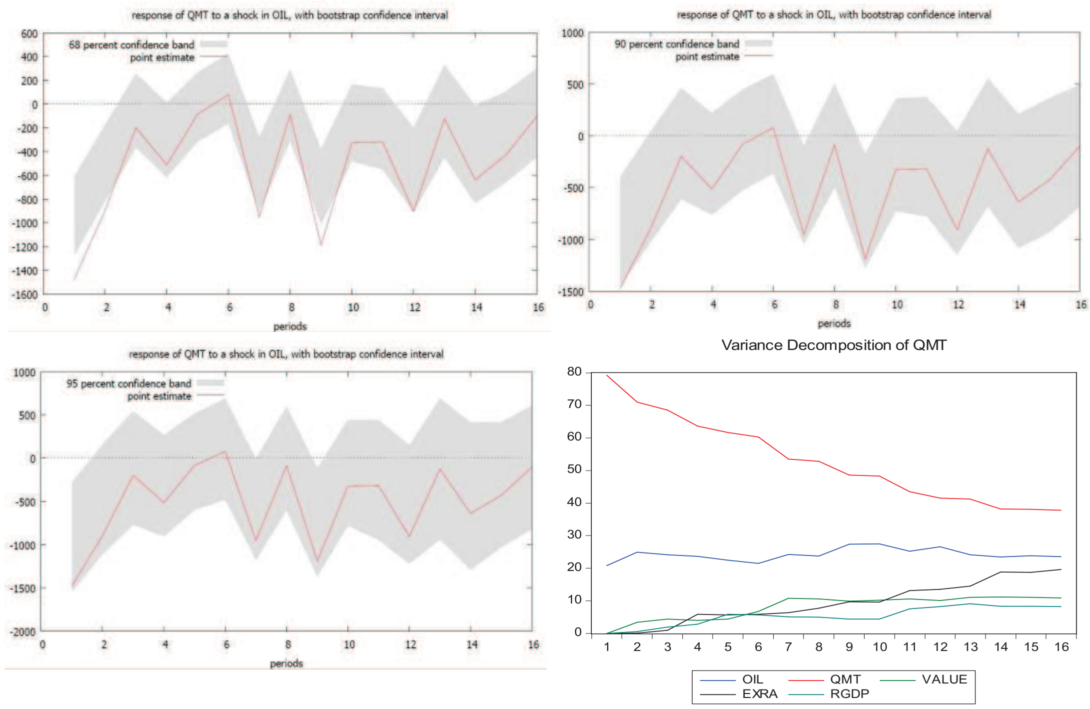
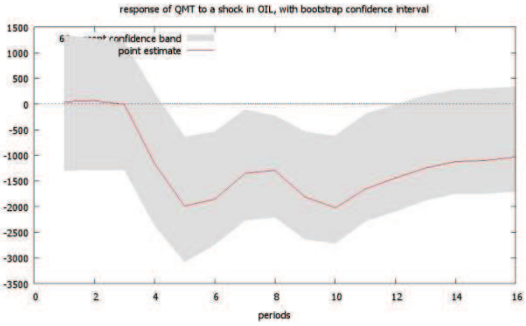
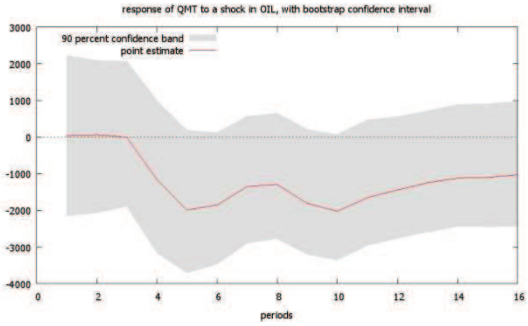


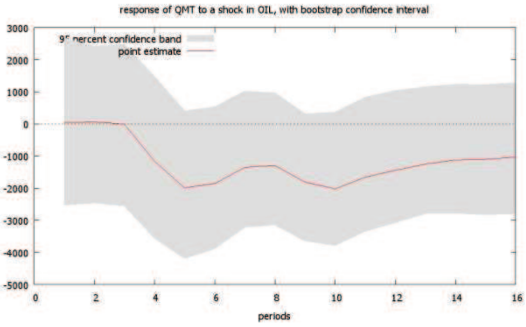
4.1.1.22 Sweden

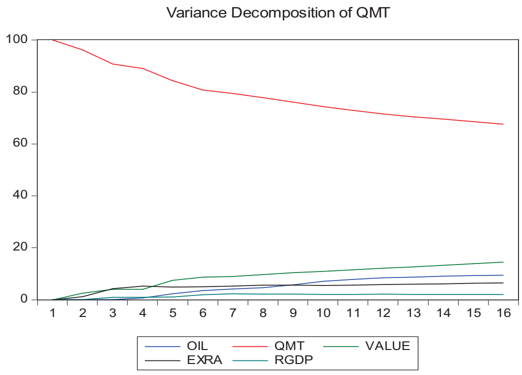


4.1.1.23 United Kingdom



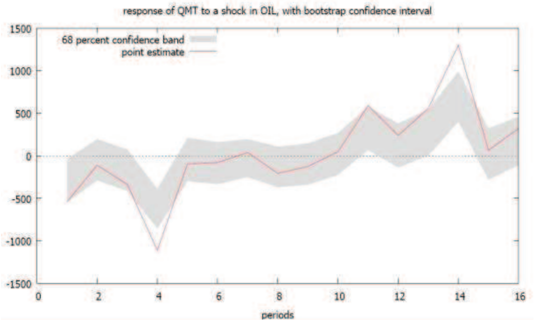


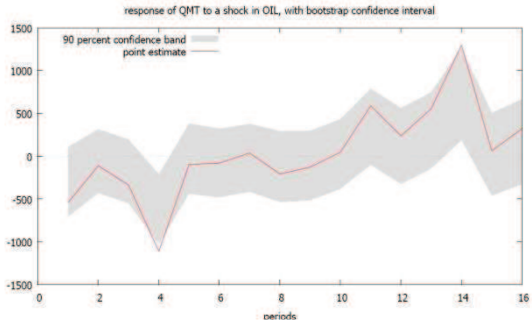


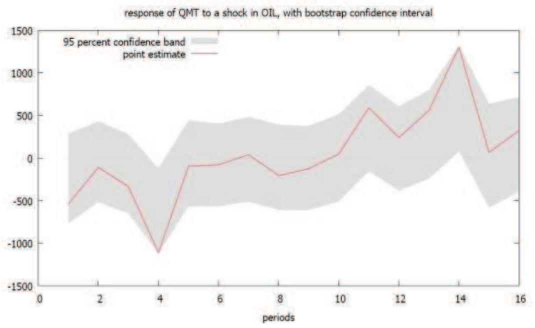


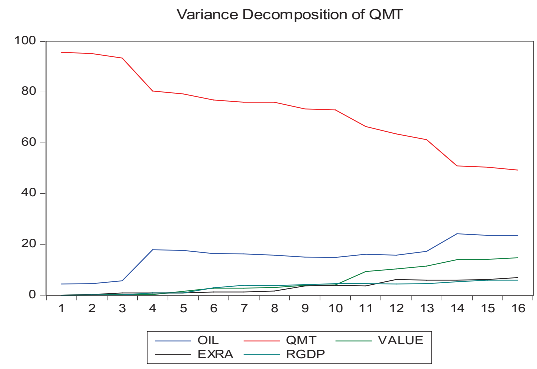
4.1.2 Other Europe

4.1.2.1 Norway

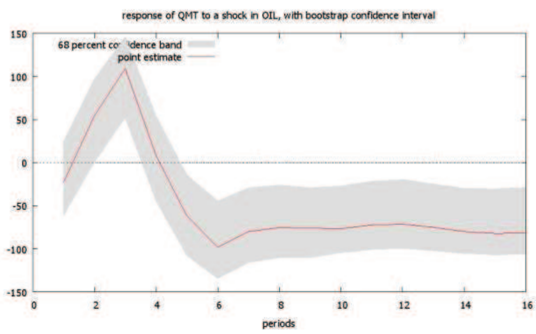


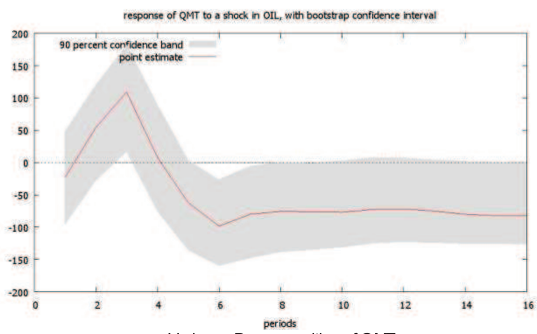


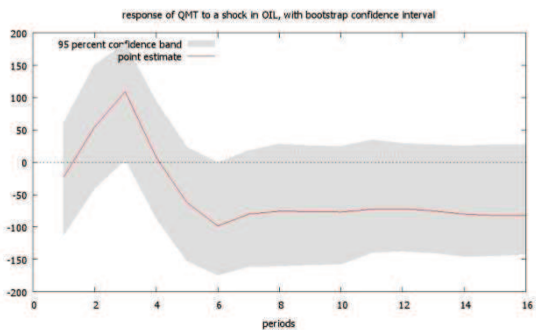


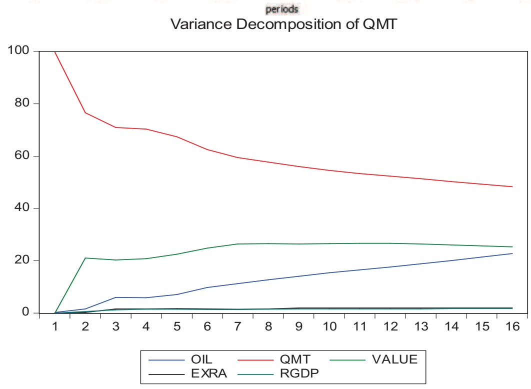


4.1.2.2 Switzerland



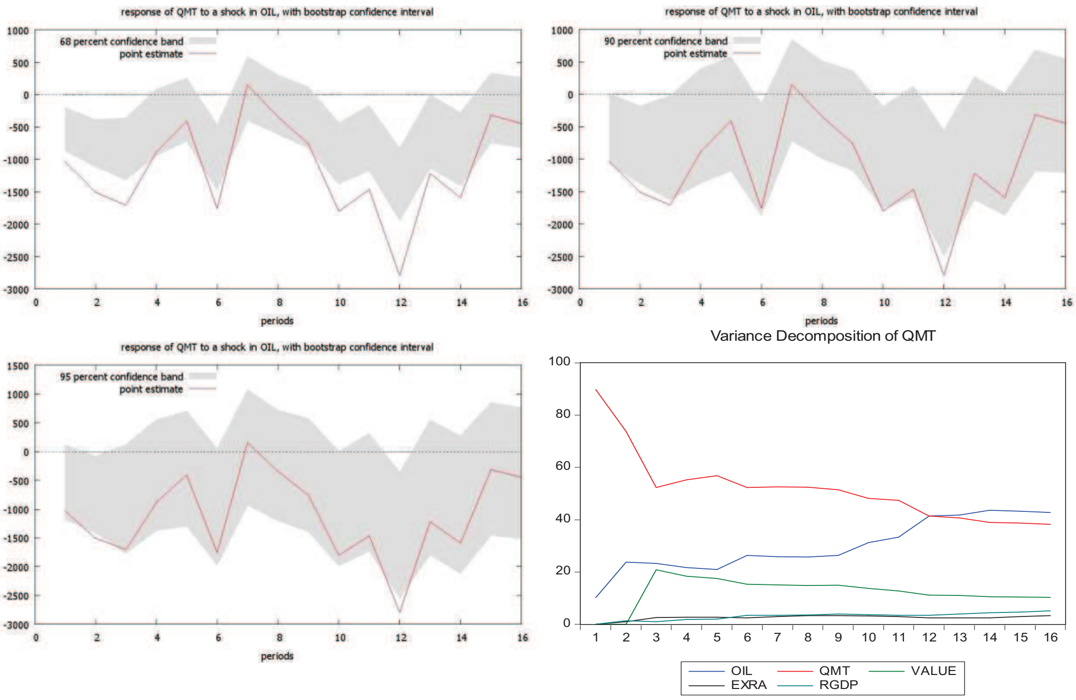




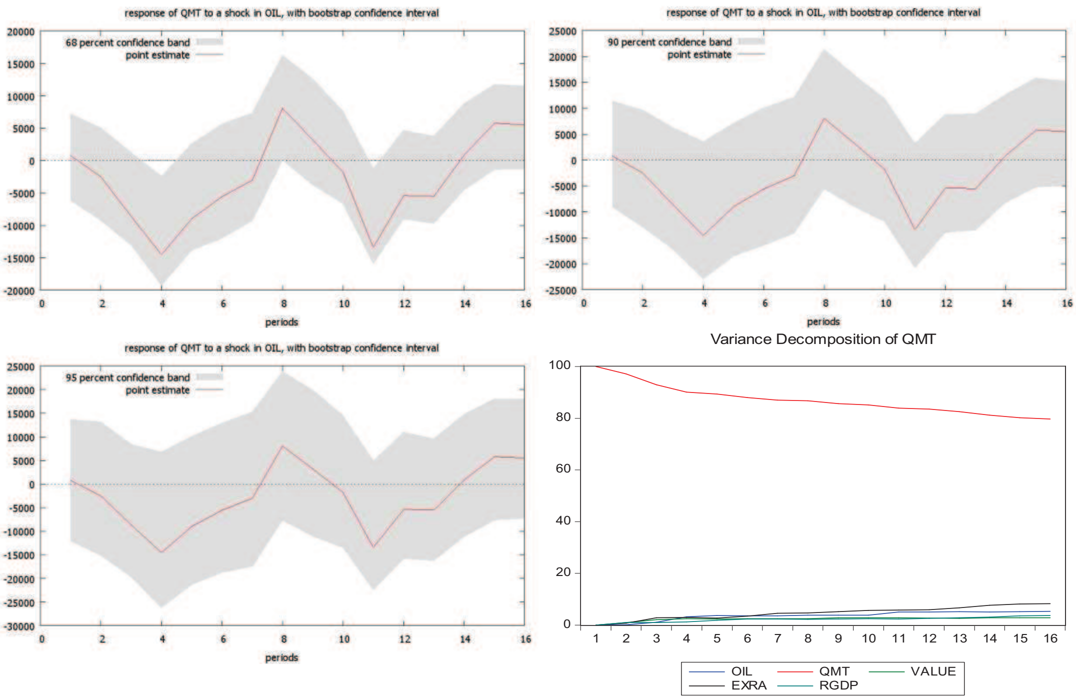


4.1.3 C.I.S.

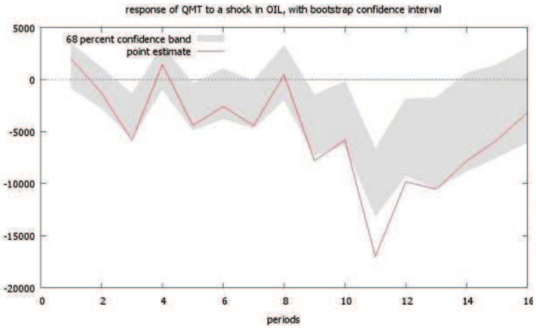
4.1.3.1 Kazakhstan

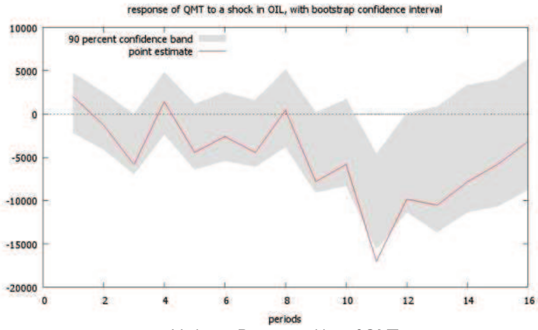


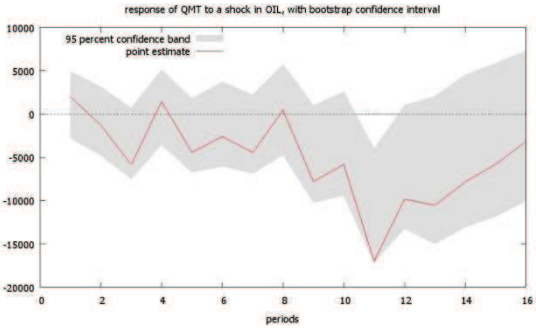
4.1.3.2 Russia

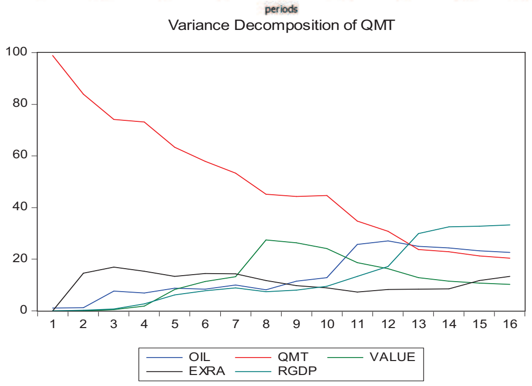


4.1.3.3 Ukraine



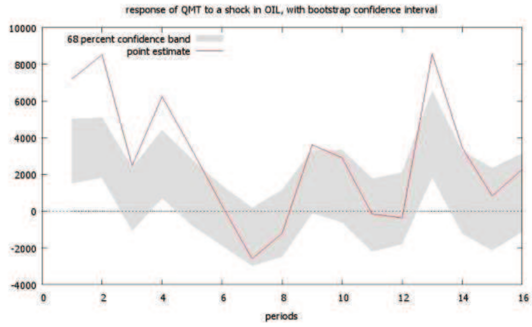


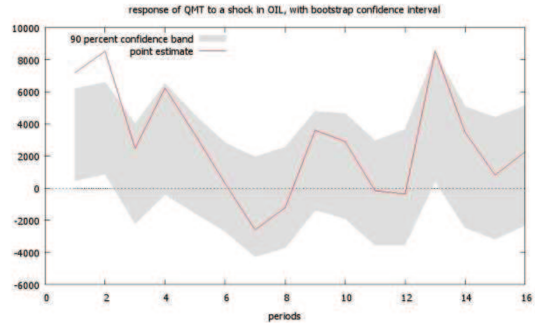


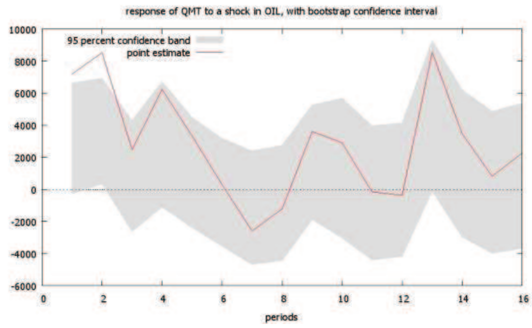


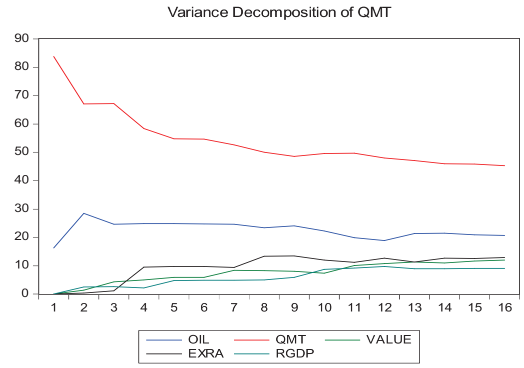
4.1.4 North America

4.1.4.1 Canada

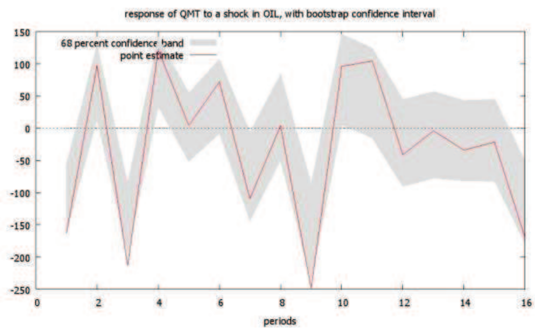


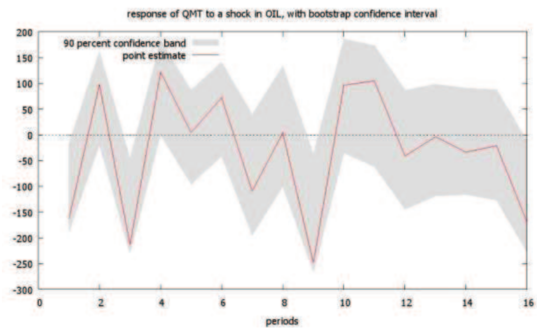


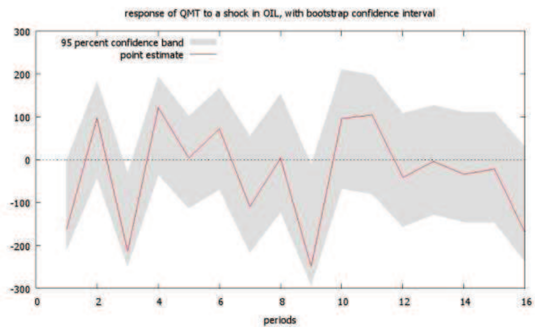


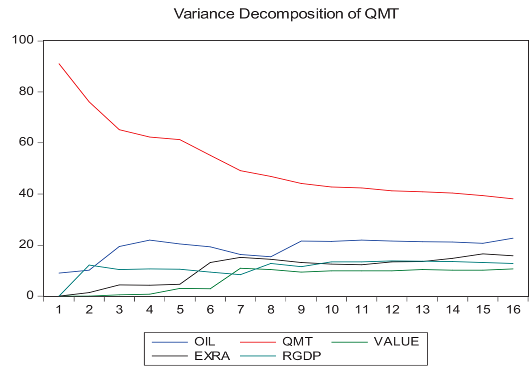


4.1.4.2 Costa Rica

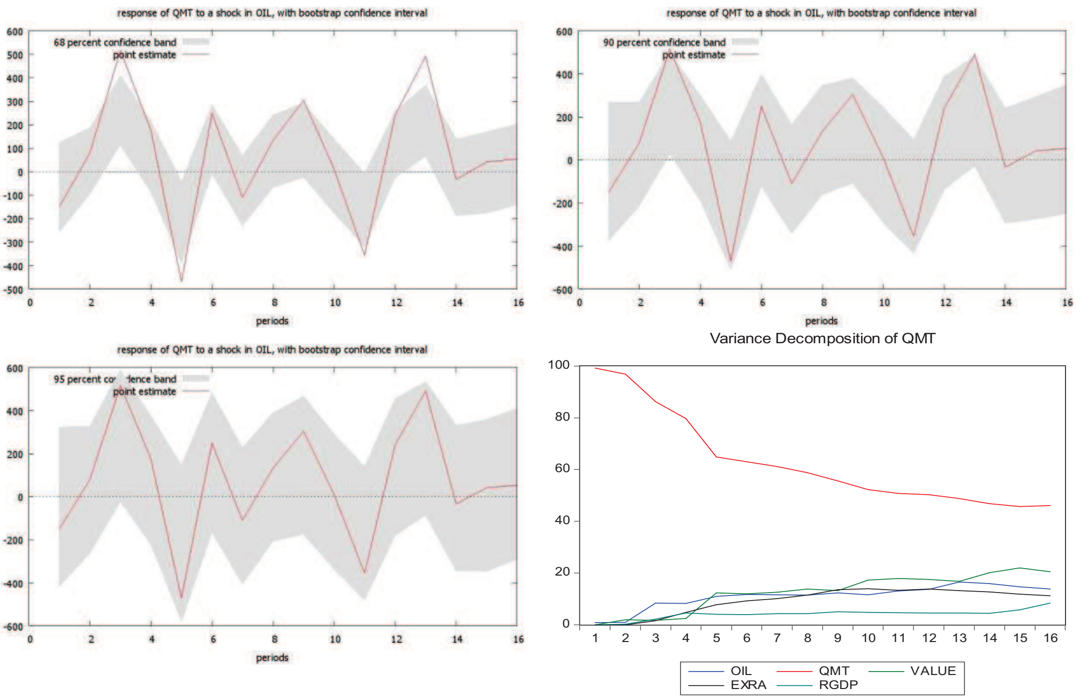




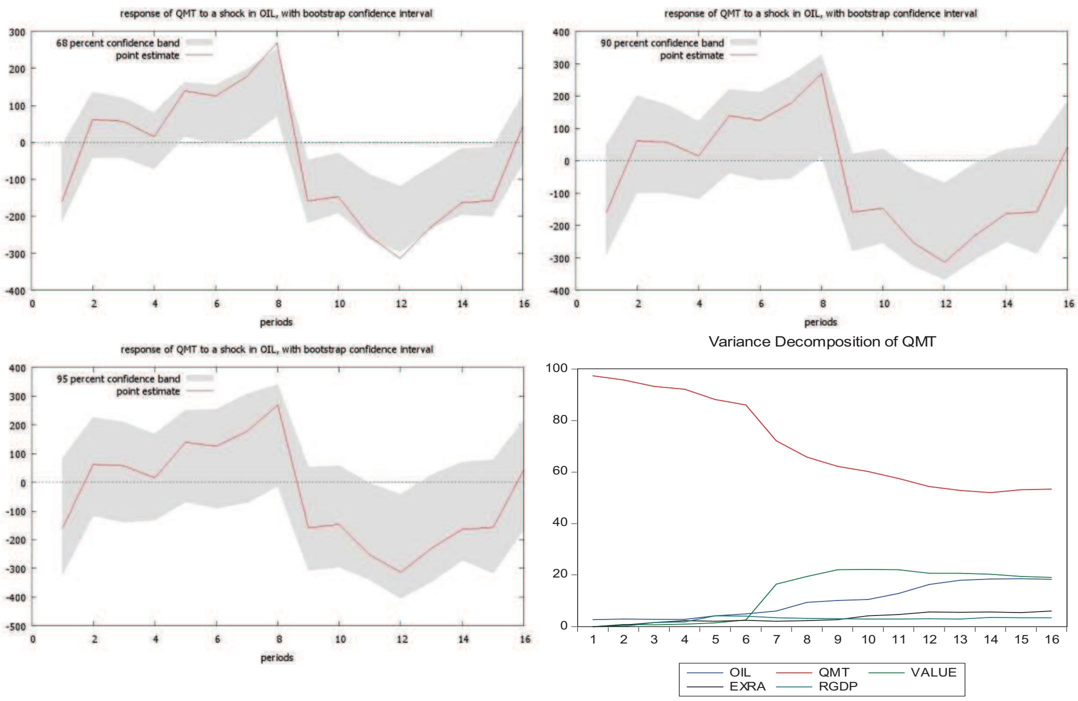




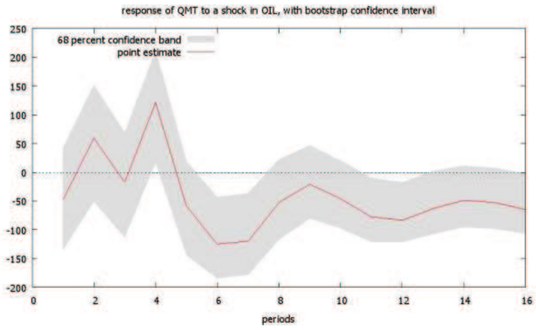
4.1.4.3 Dominican Republic

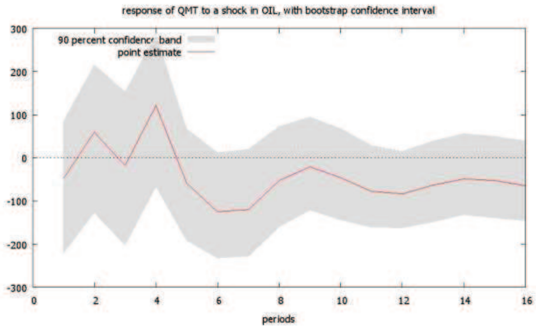


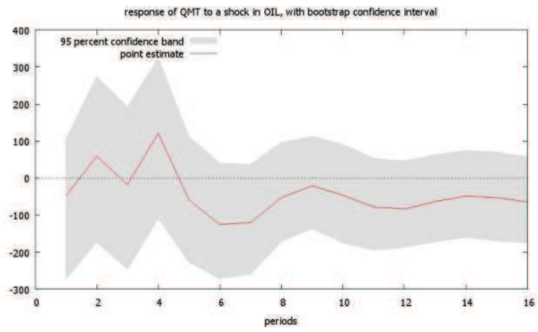
4.1.4.4 El Salvador

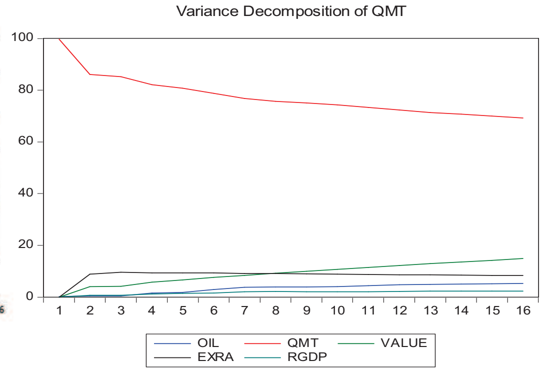


4.1.4.5 Guatemala

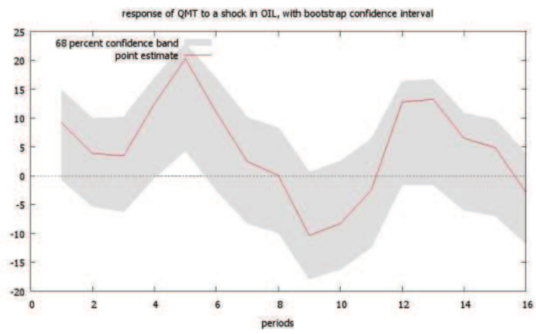


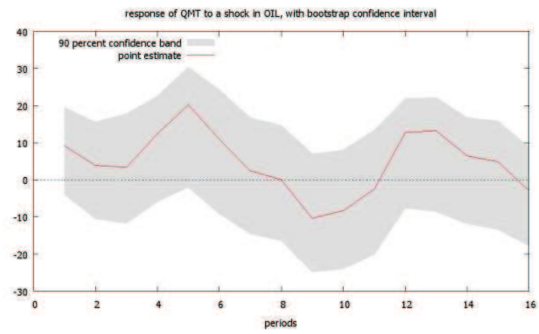


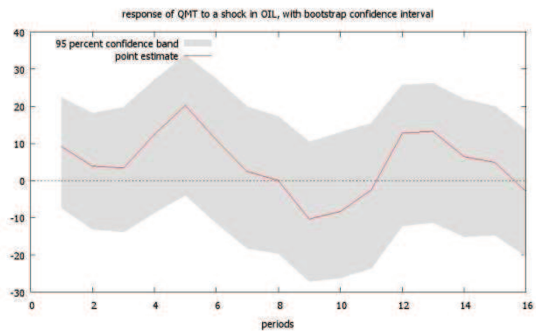


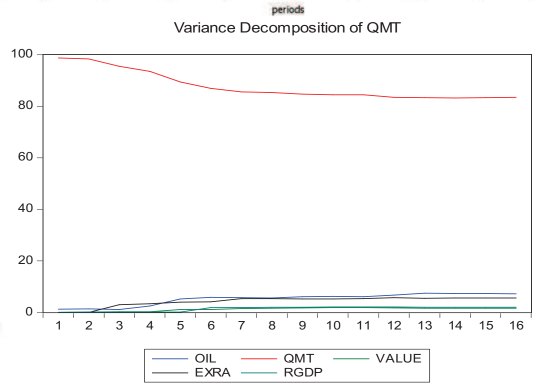


4.1.4.6 Honduras

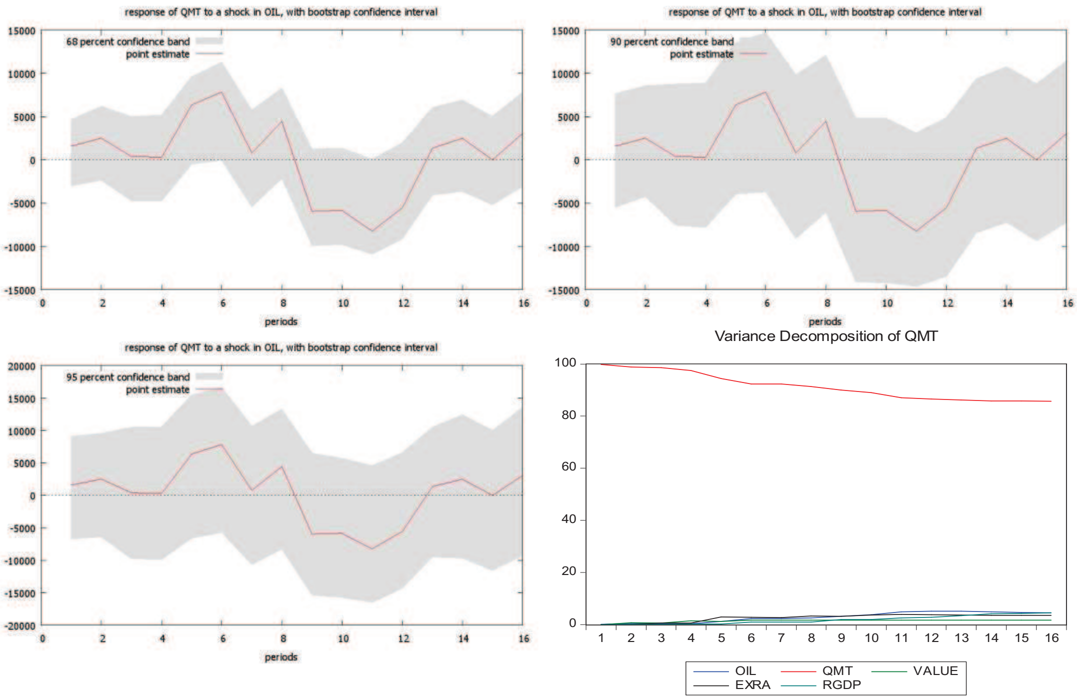




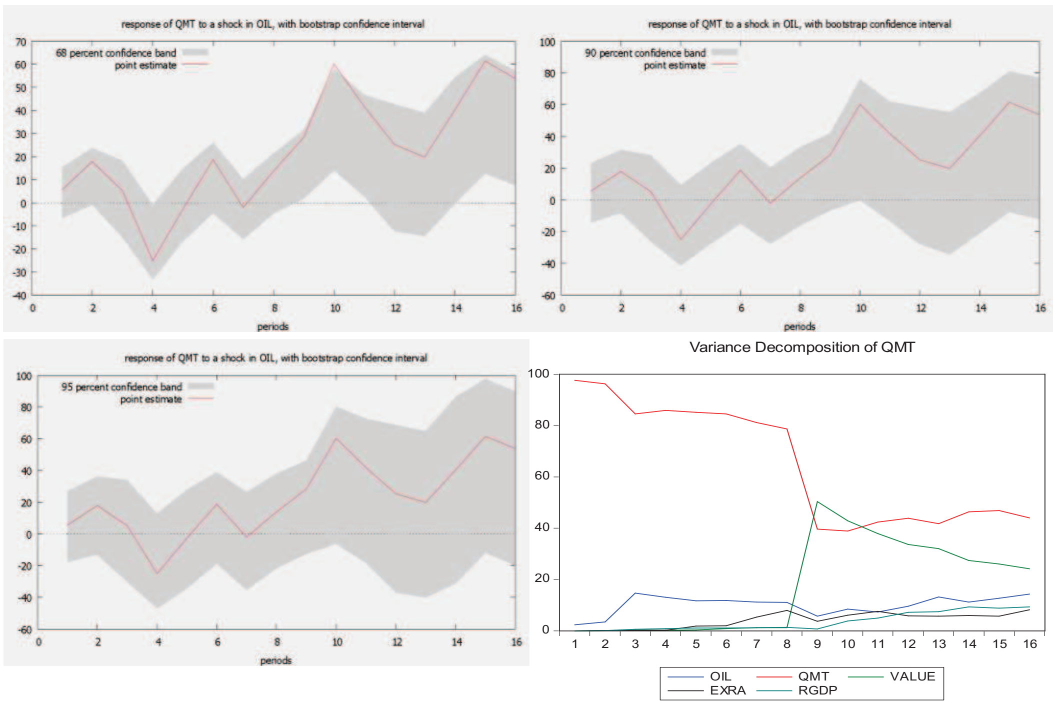




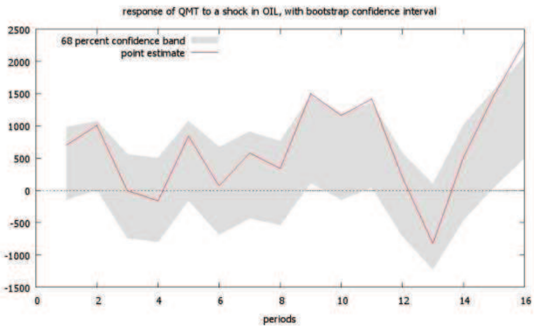
4.1.4.7 Mexico

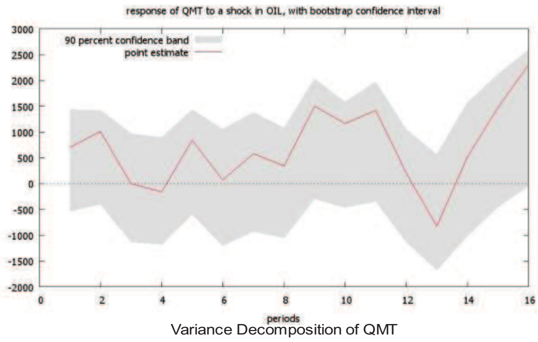


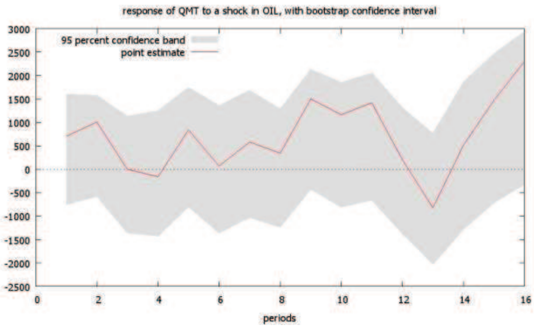
4.1.4.8 Panama

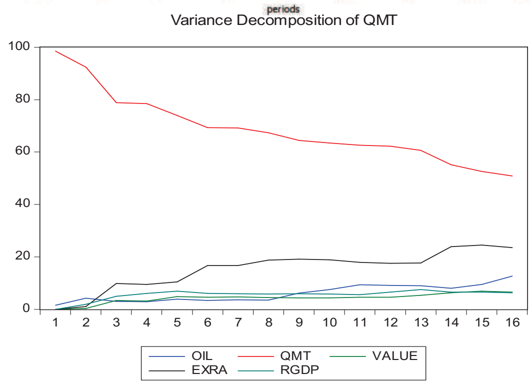


4.1.4.9 Trinidad and Tobago



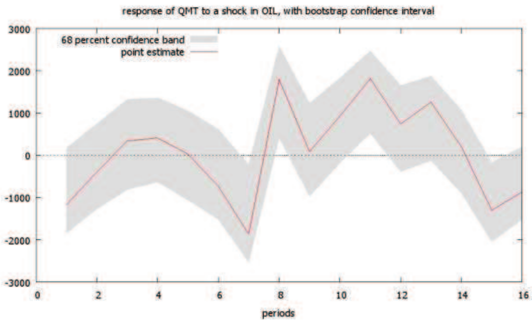


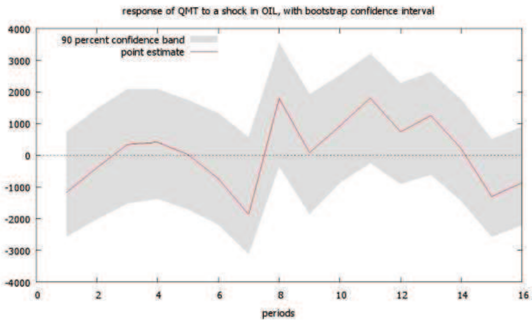


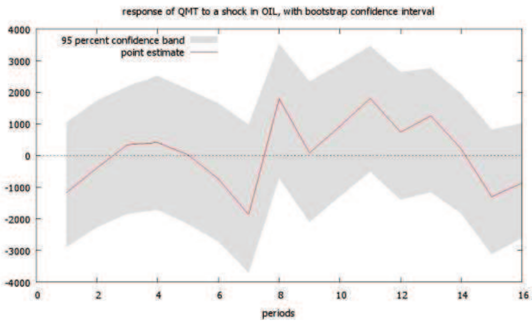


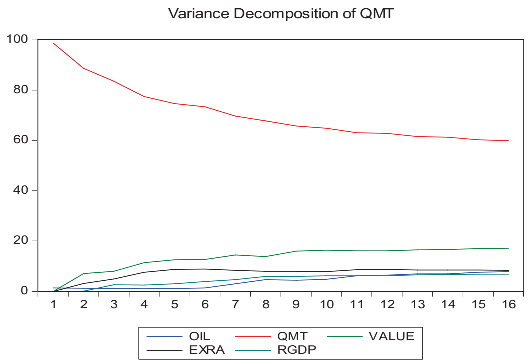
4.1.5 South America

4.1.5.1 Argentina

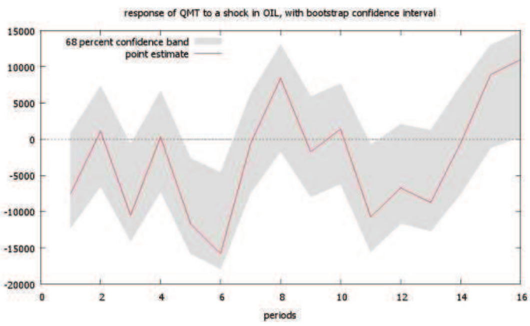


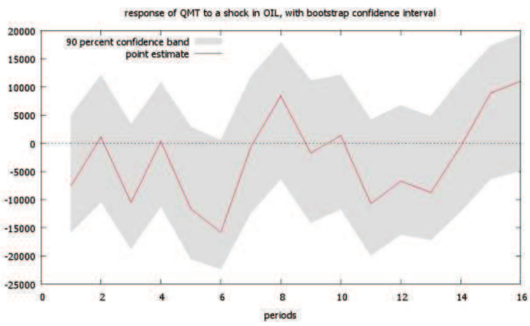


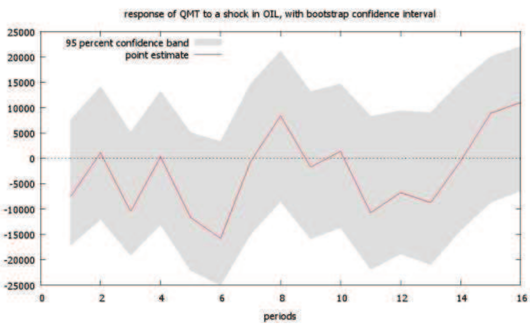


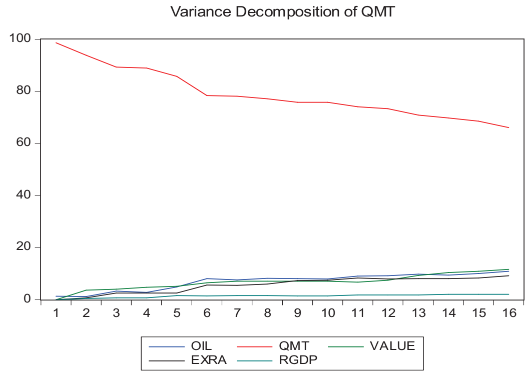


4.1.5.2 Brazil

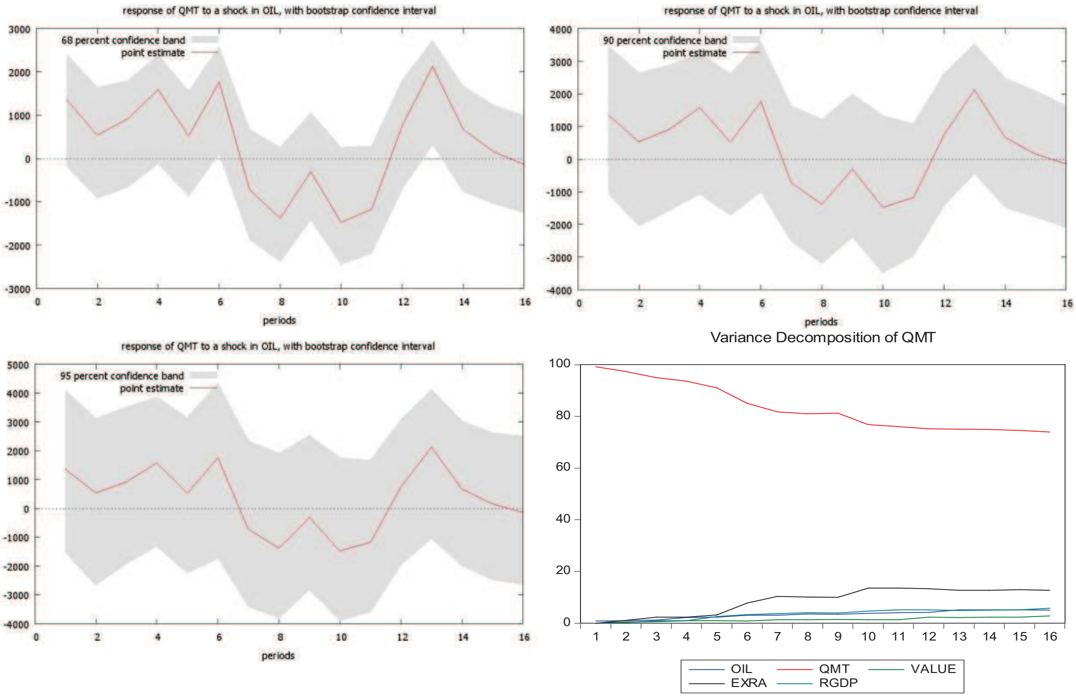




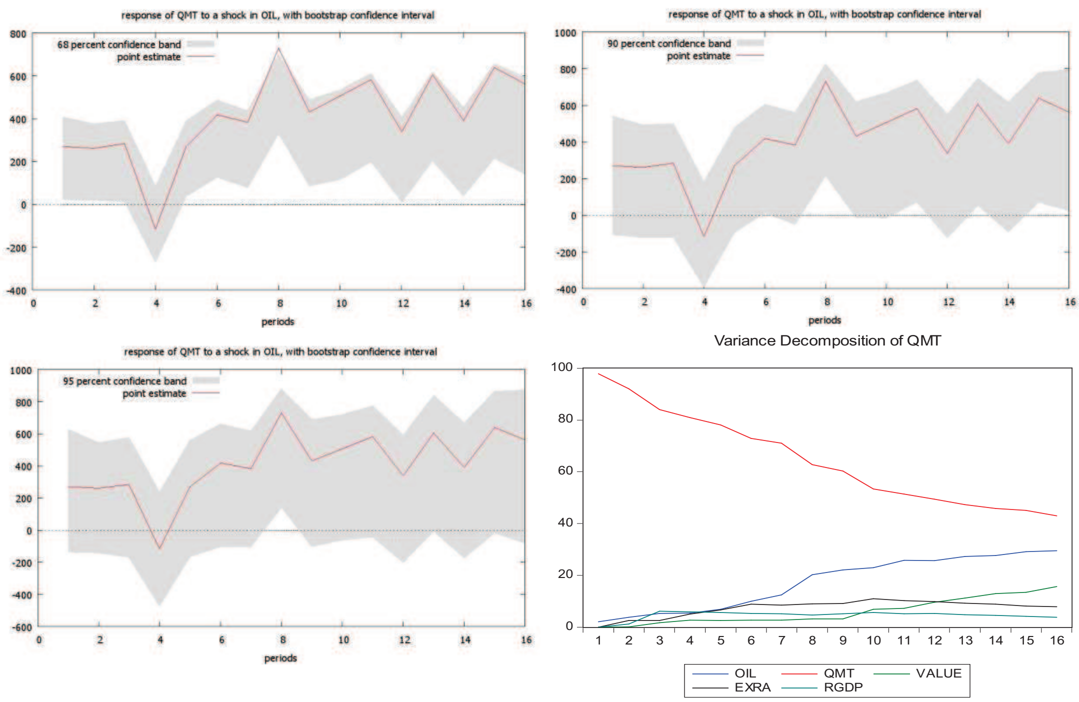




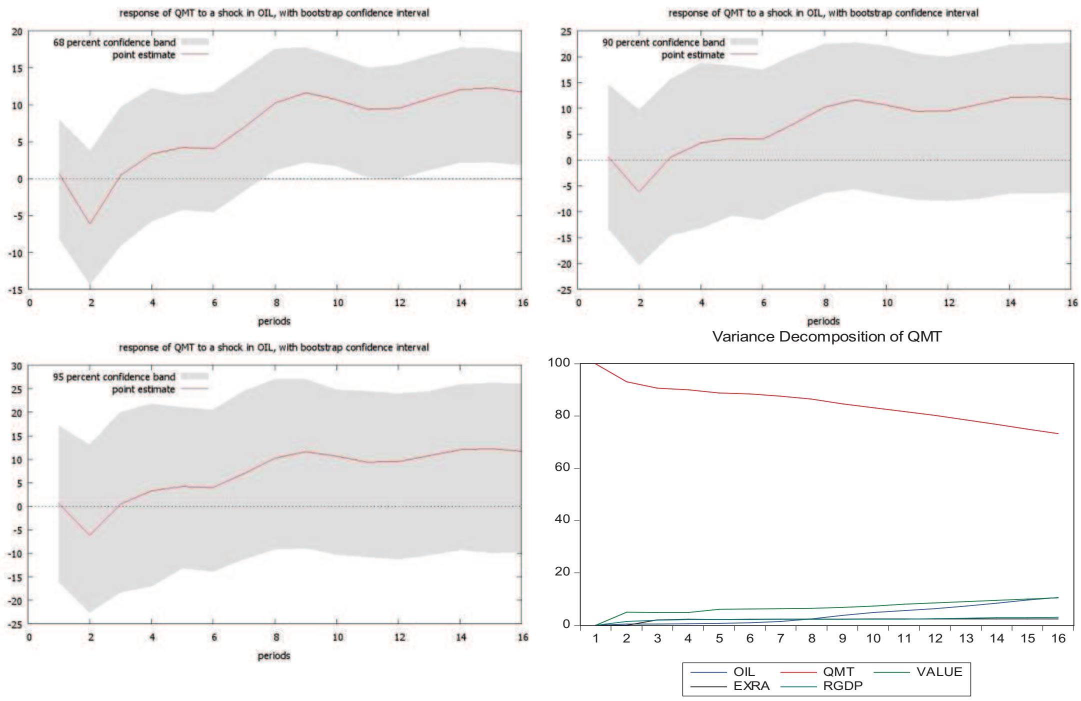
4.1.5.3 Chile



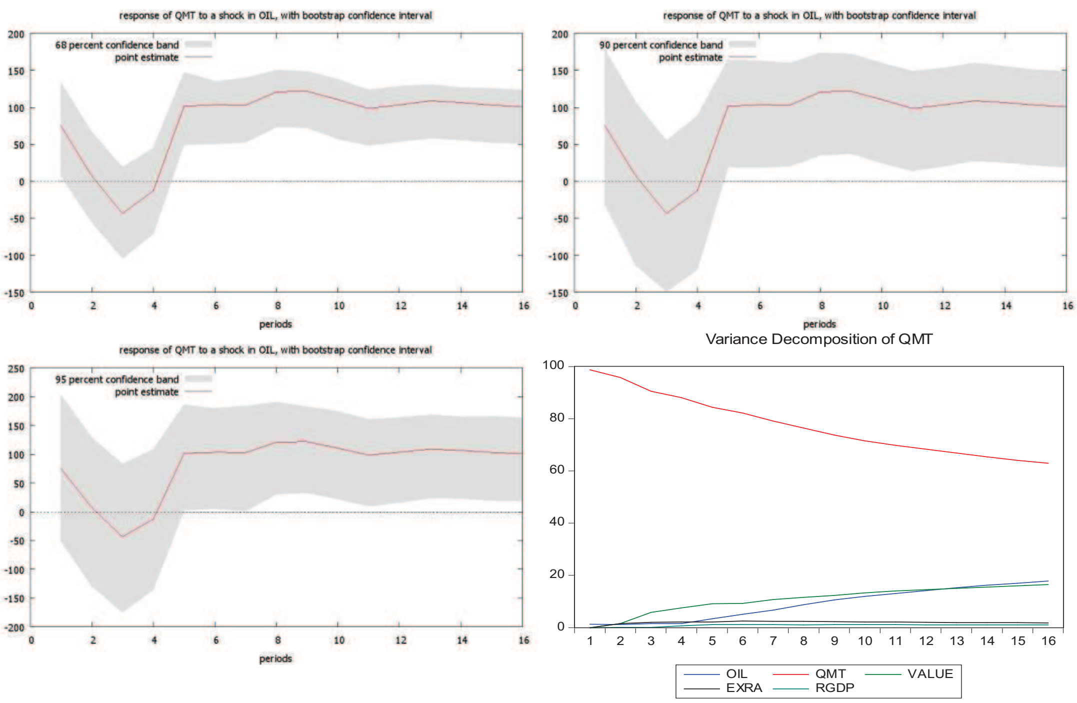
4.1.5.4 Colombia



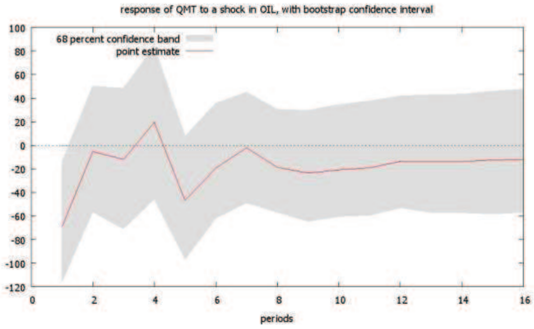
4.1.5.5 Ecuador

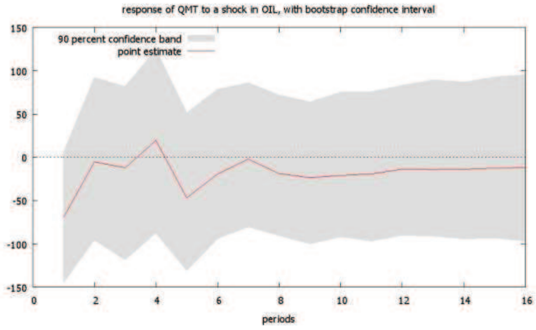


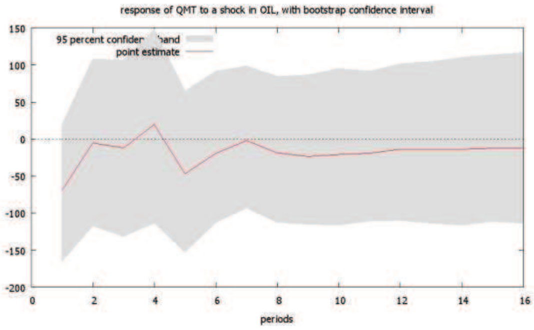
4.1.5.6 Peru

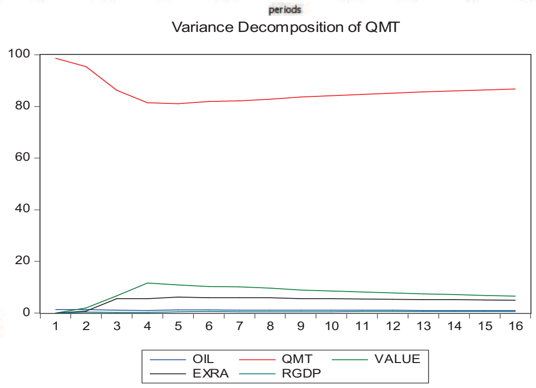


4.1.5.7 Uruguay



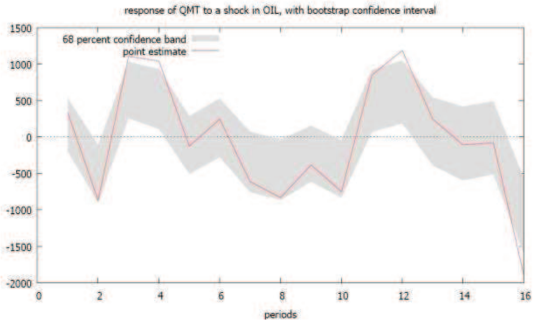


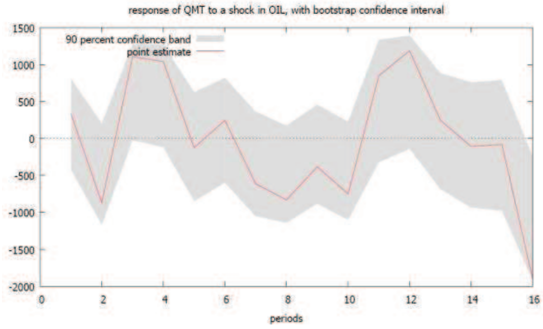


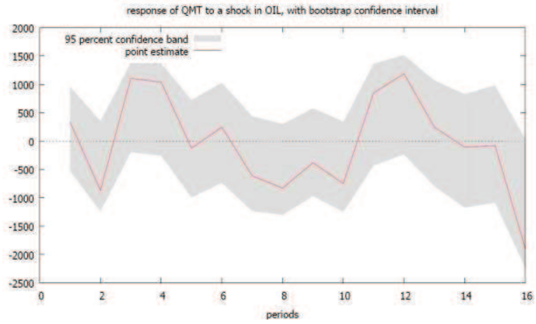


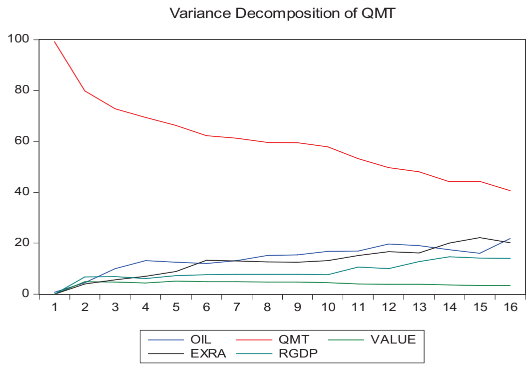
4.1.6 Africa

4.1.6.1 Algeria

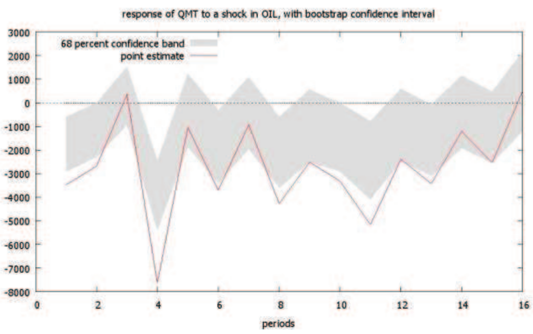


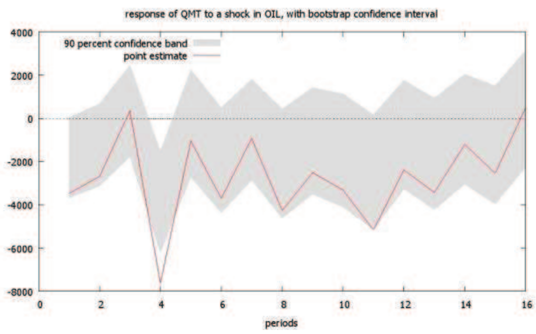


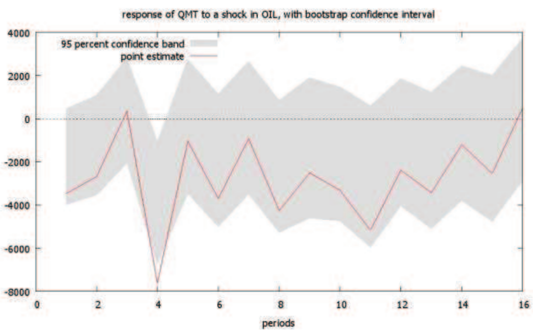


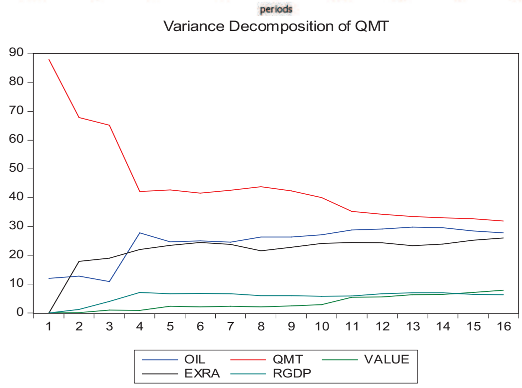


4.1.6.2 Egypt









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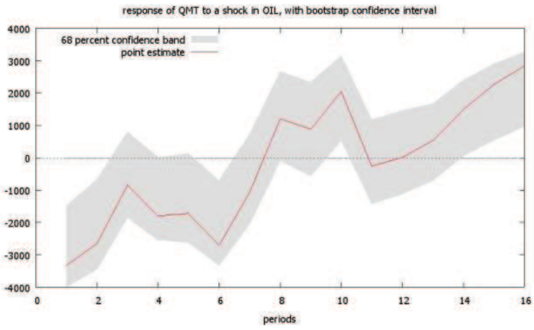
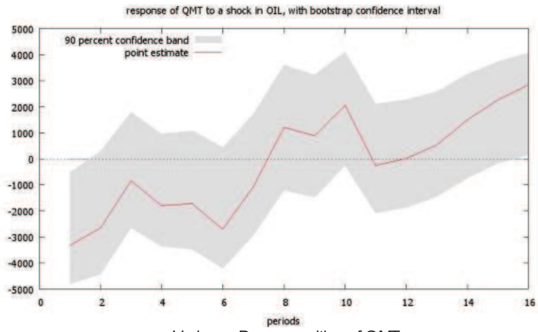
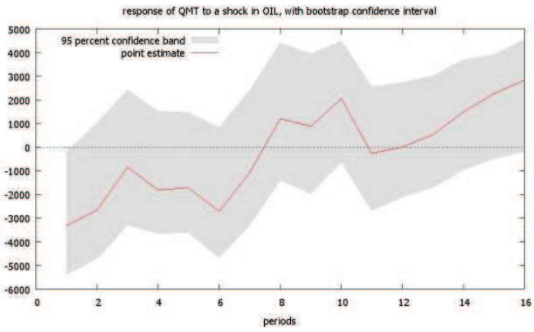
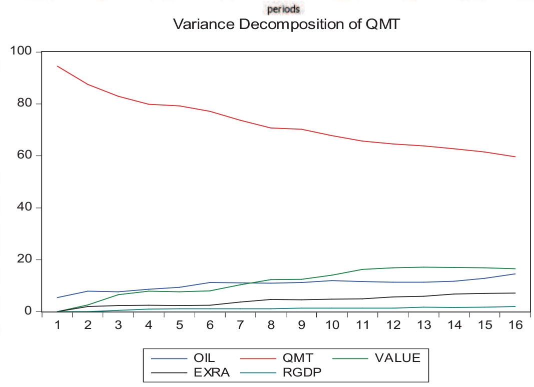


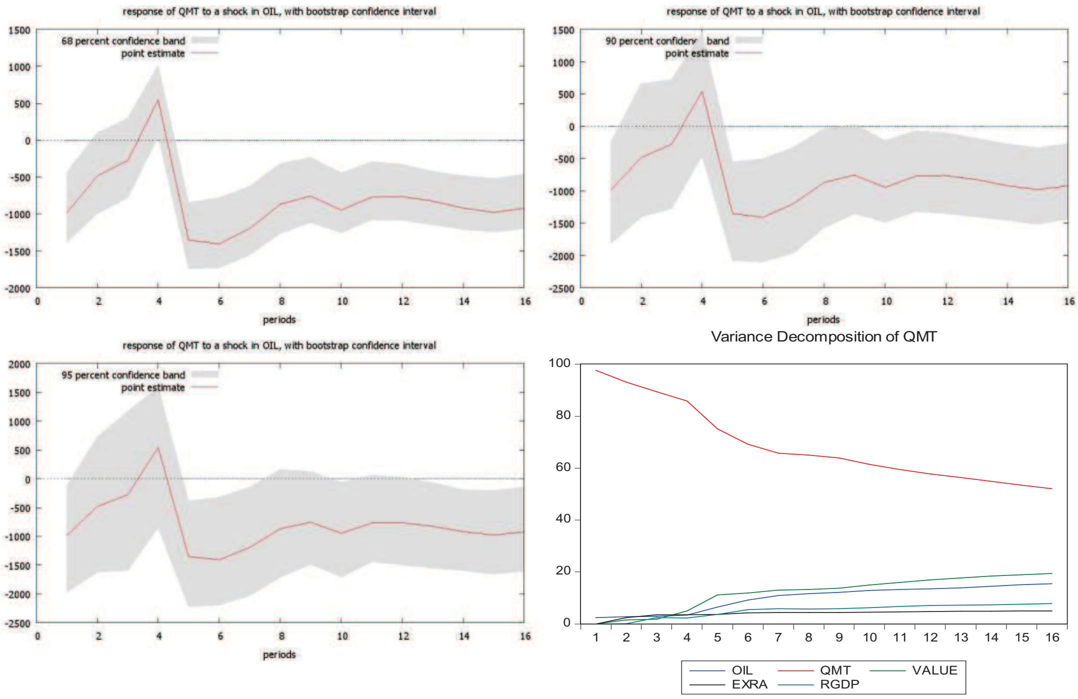






4.1.7 Middle East

4.1.7.1 Israel



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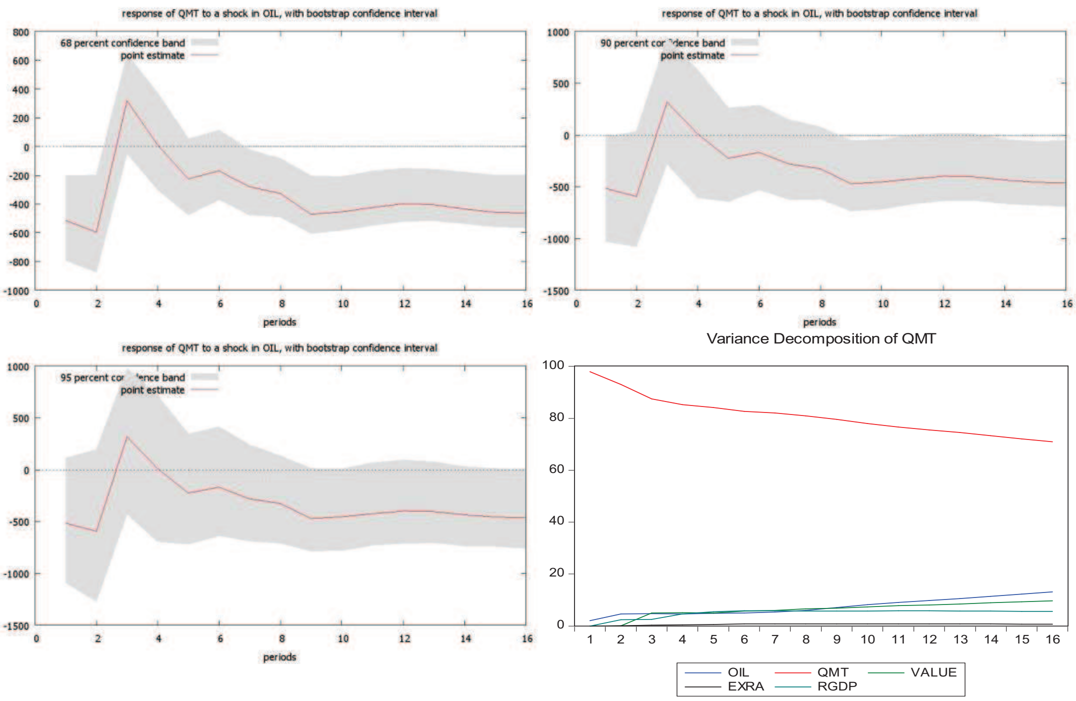

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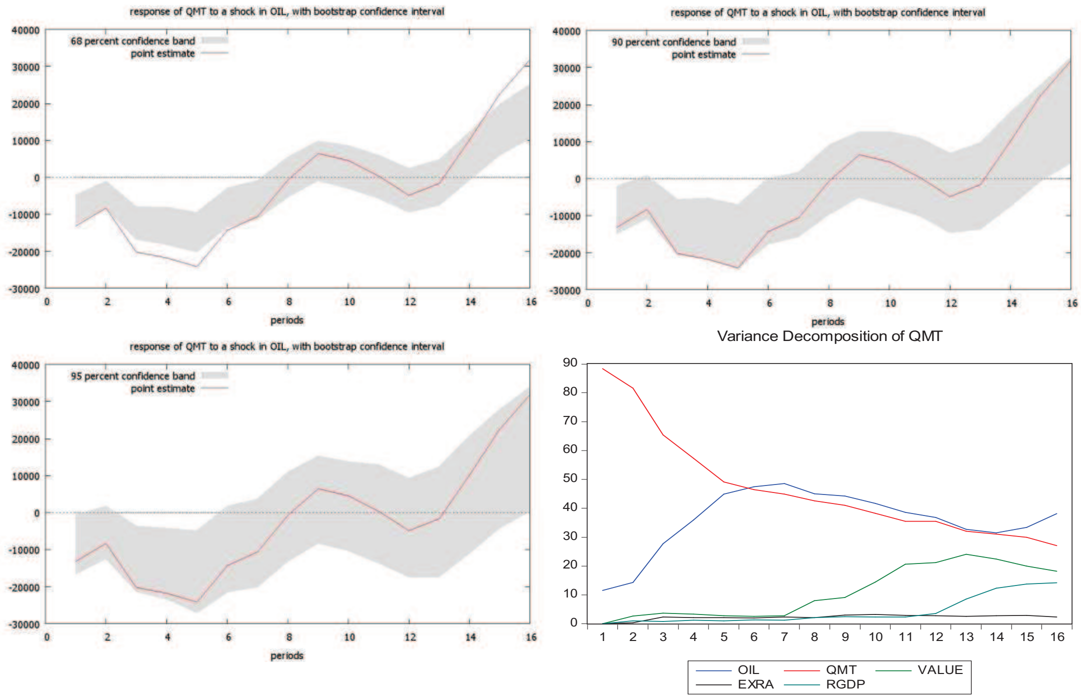

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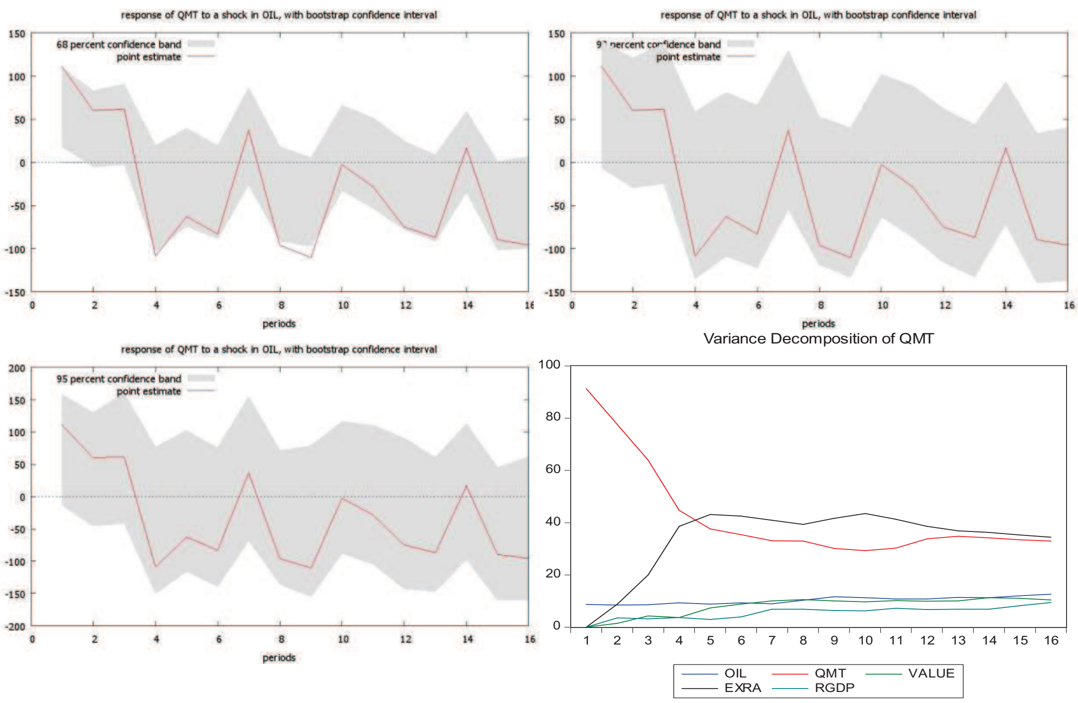
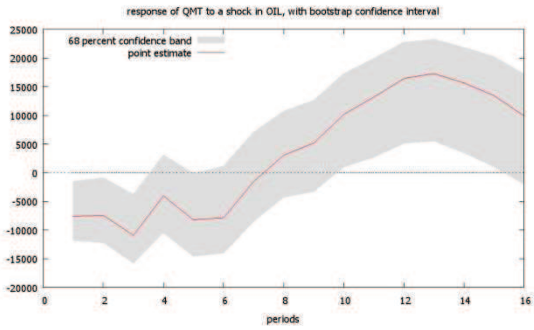
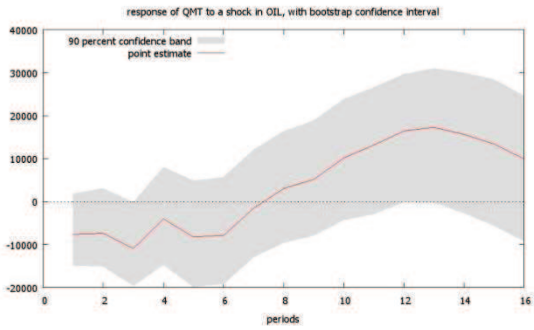
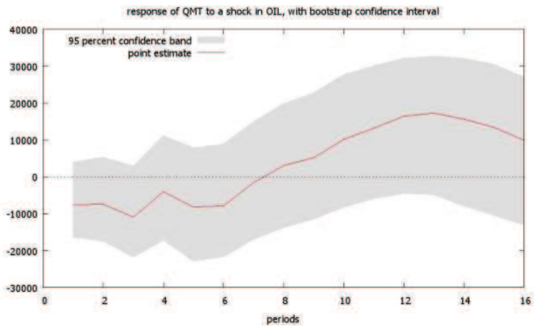


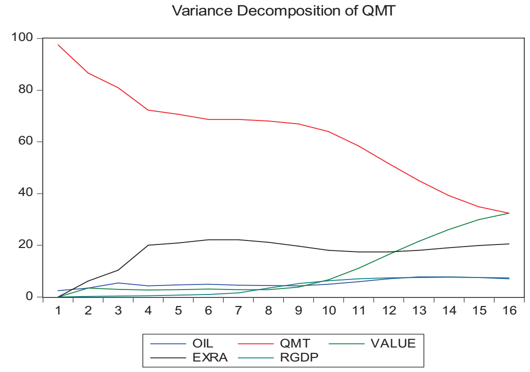
4.1.8 Asia

4.1.8.1 China









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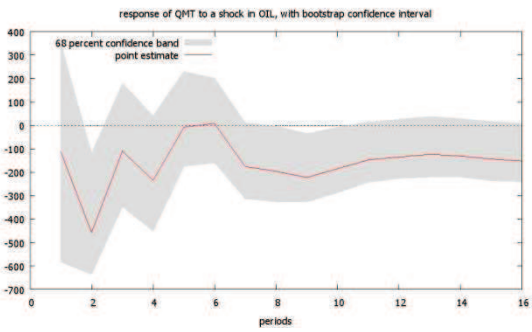

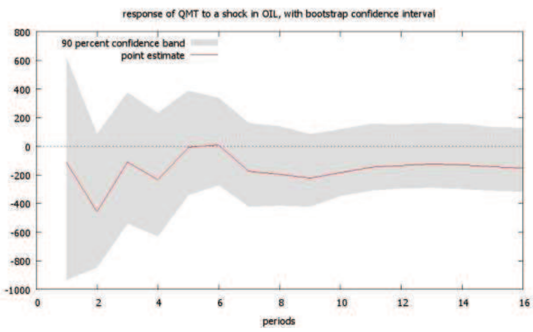

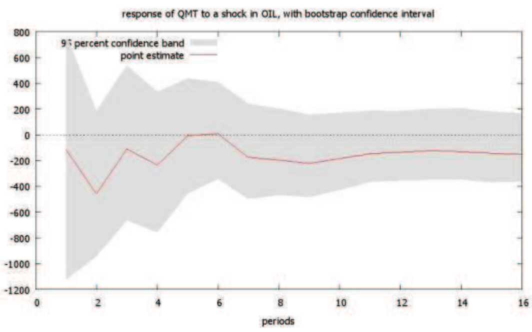

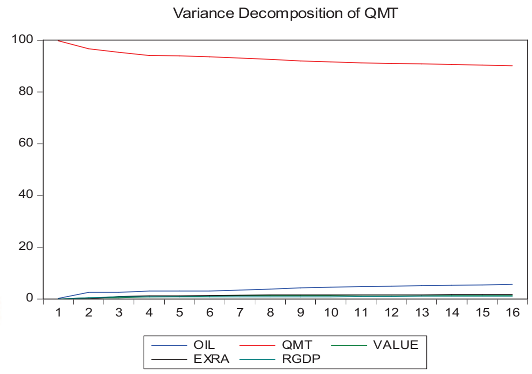

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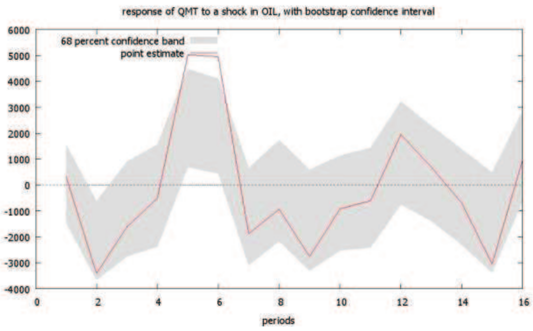

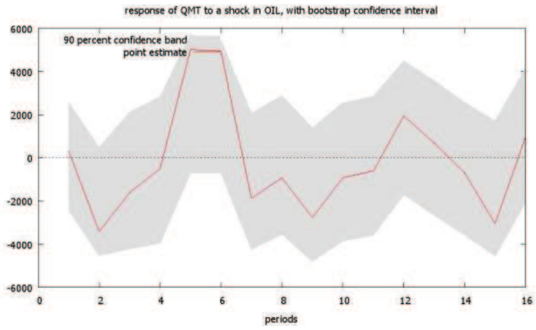

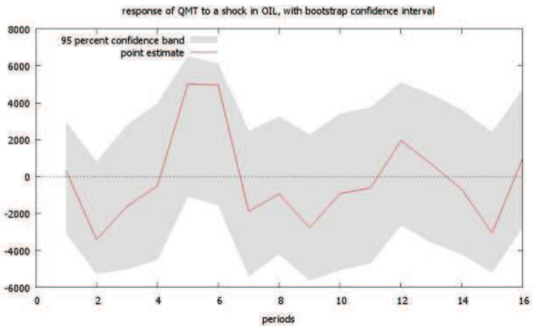

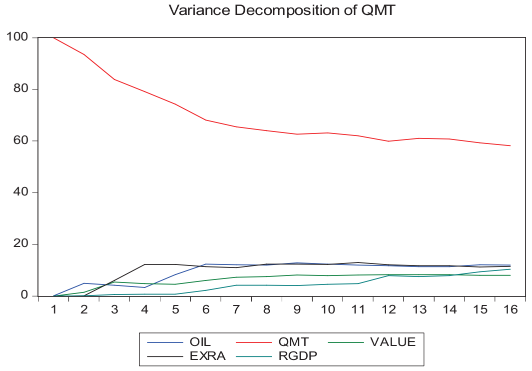

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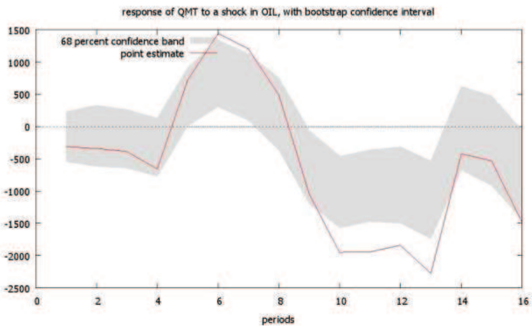

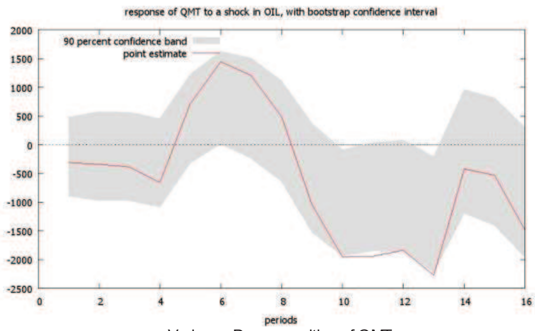

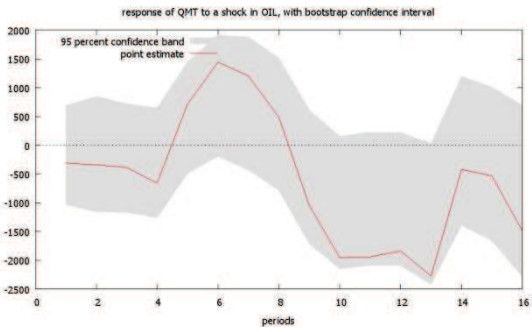

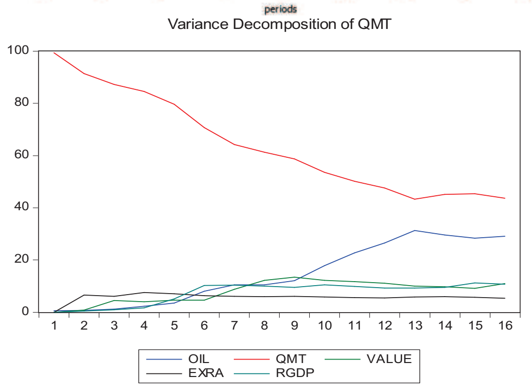

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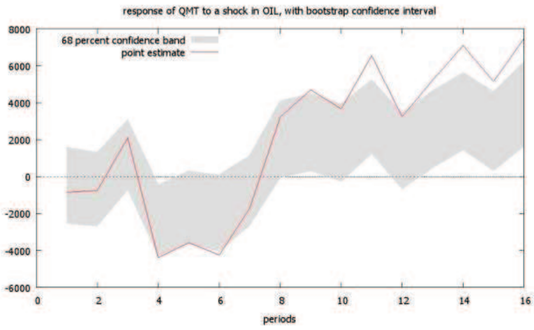

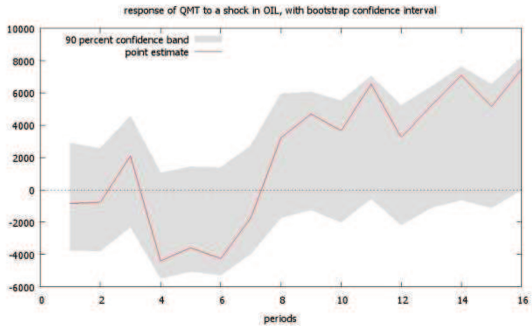

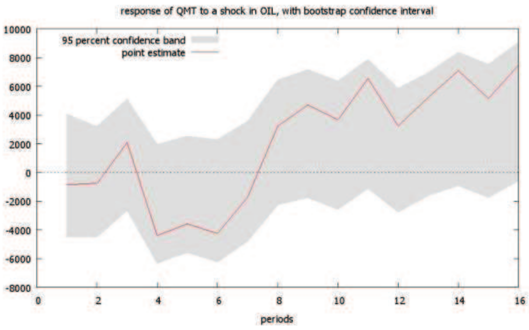

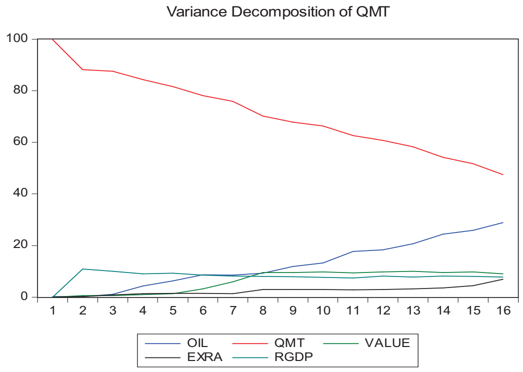

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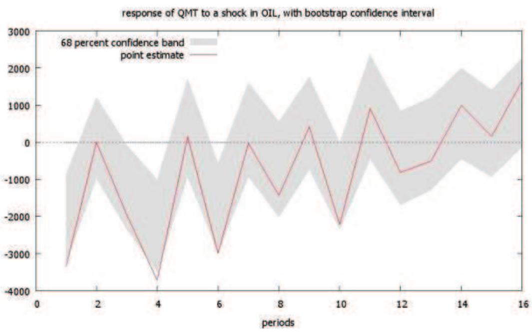

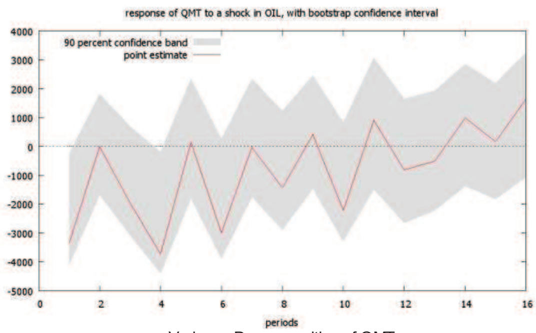

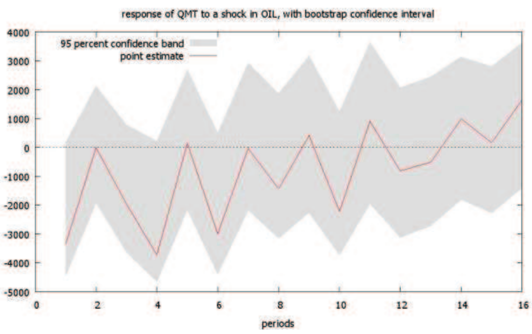

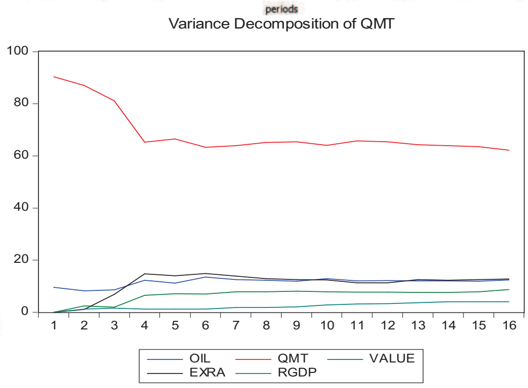

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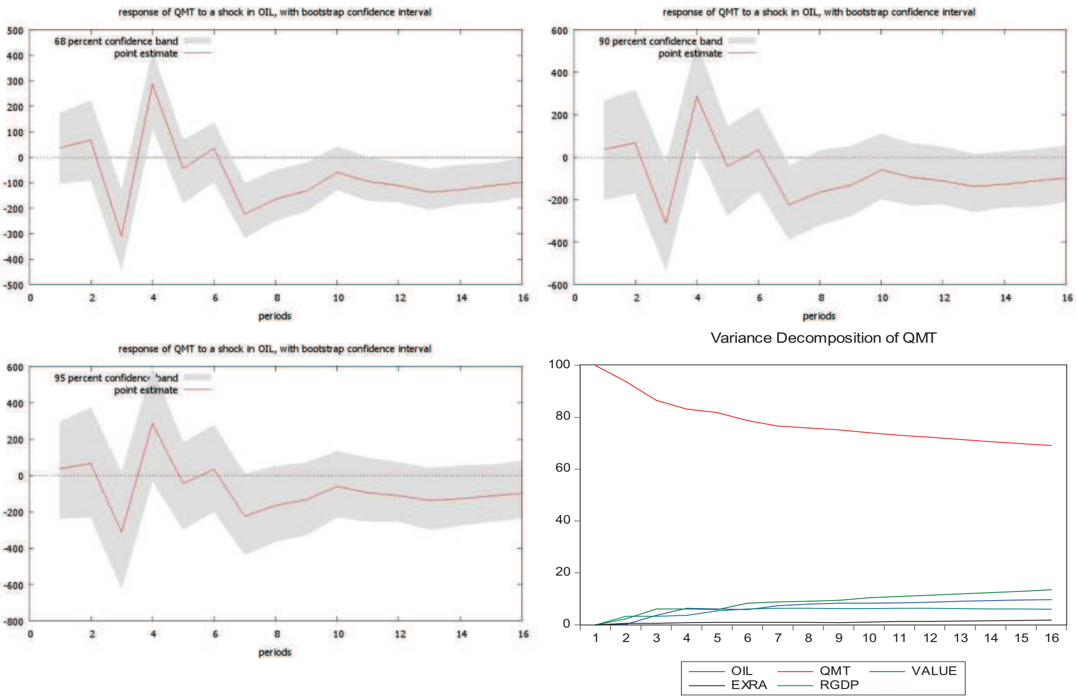

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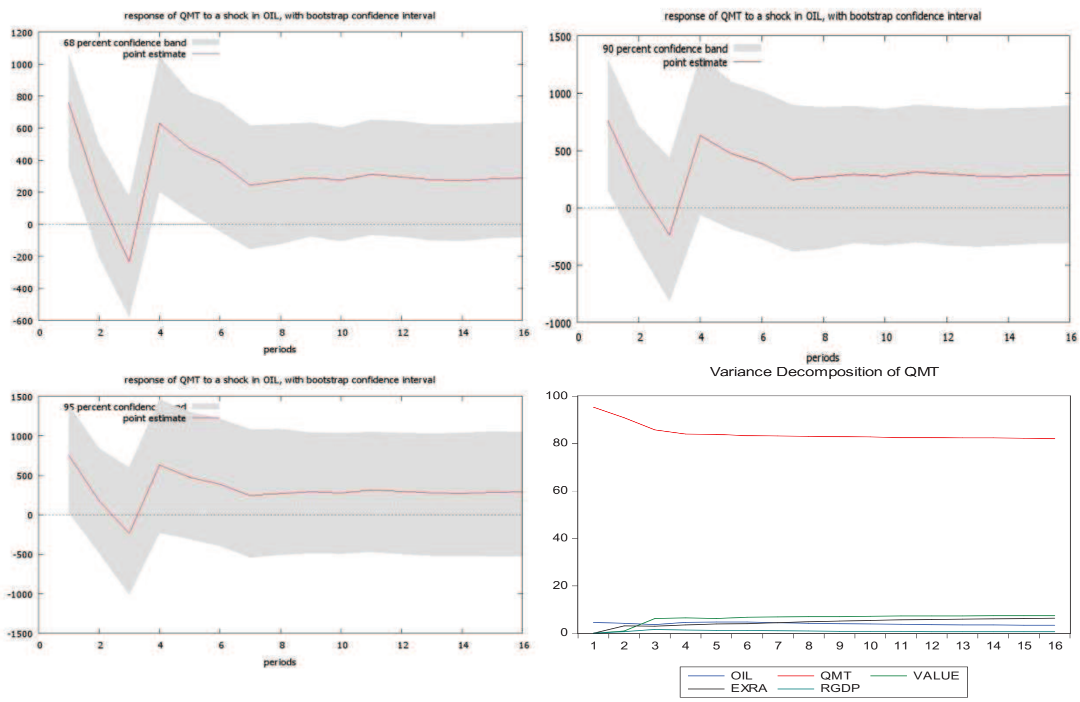

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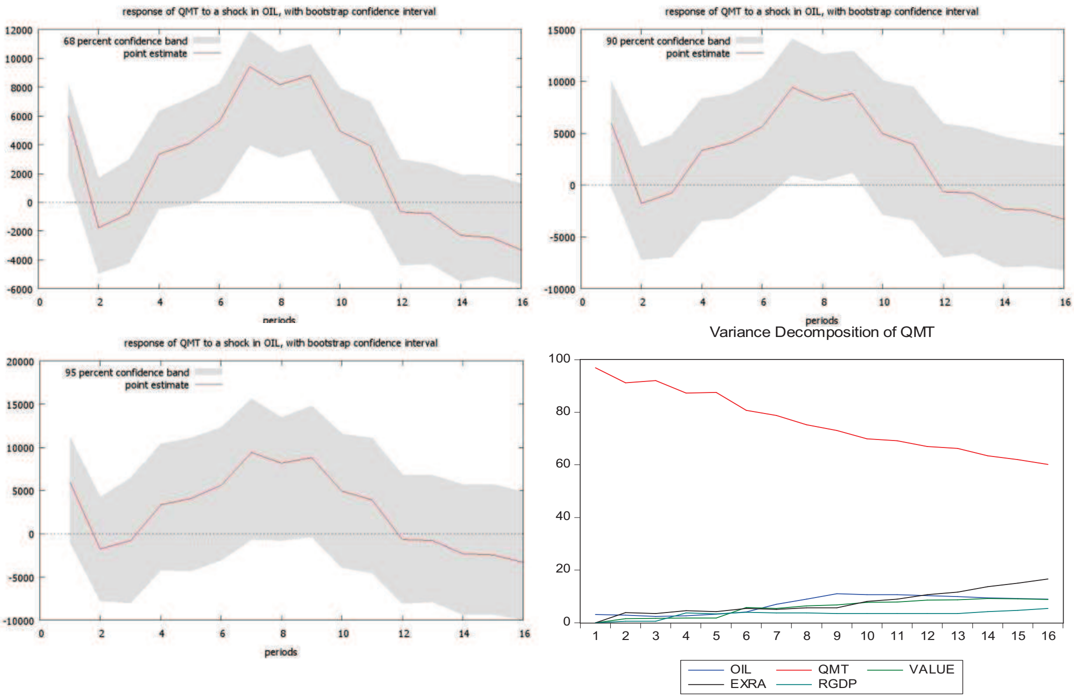

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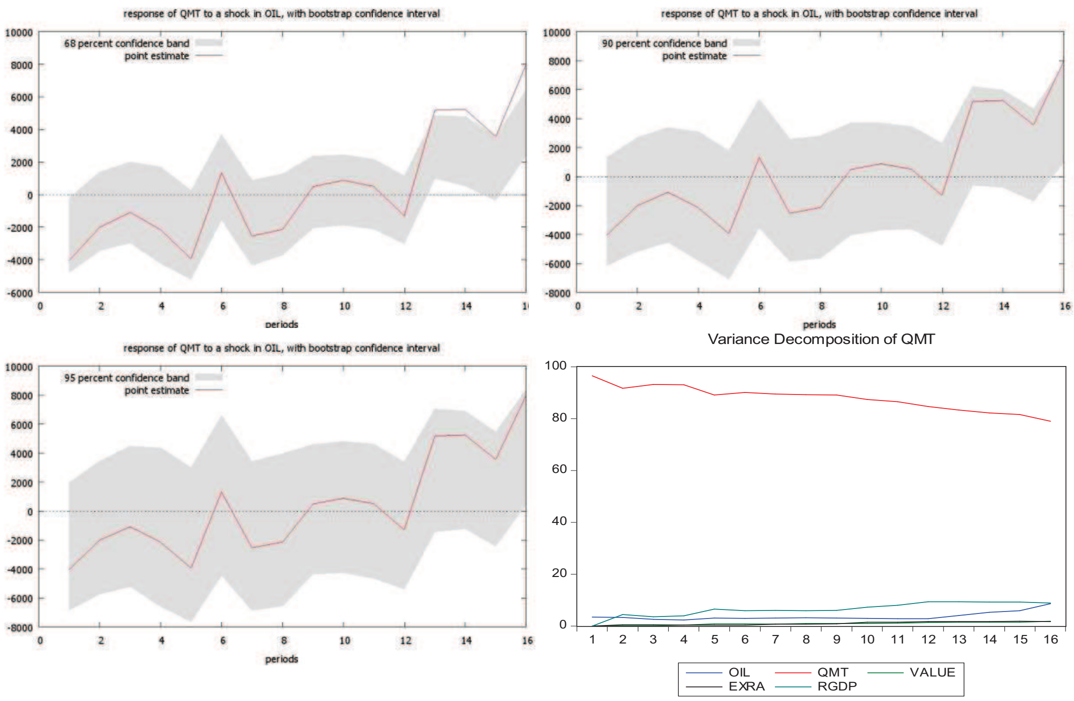

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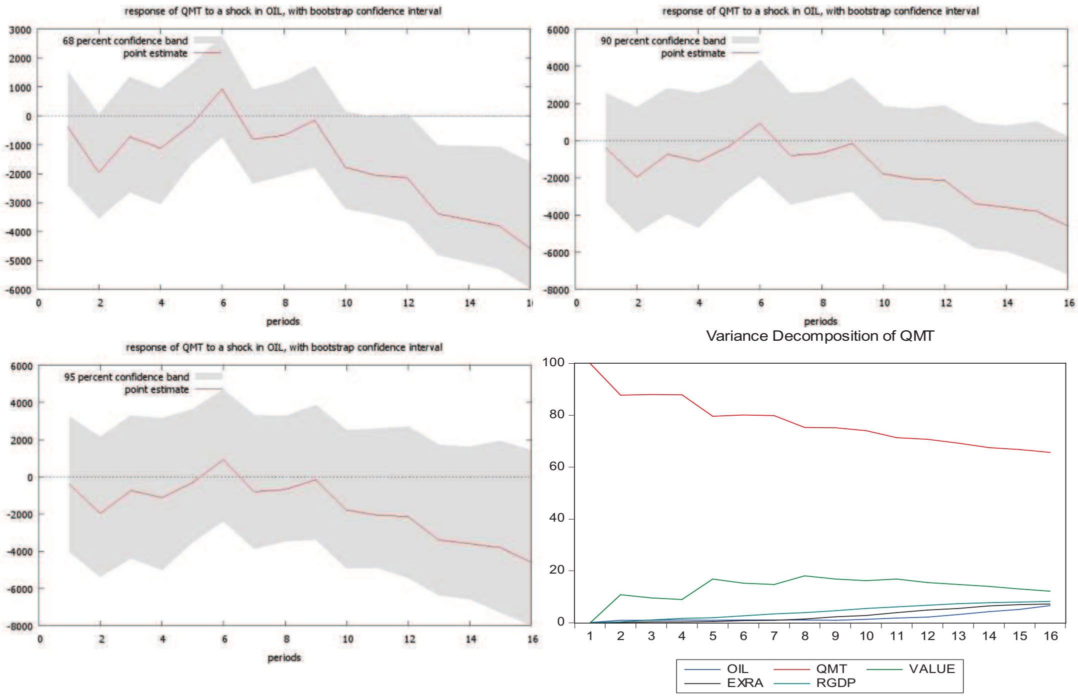
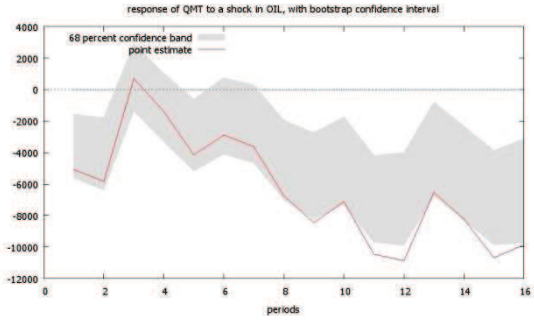
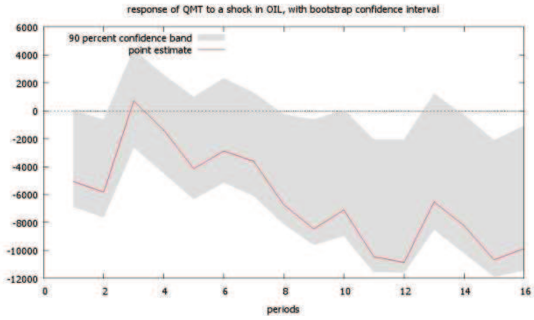
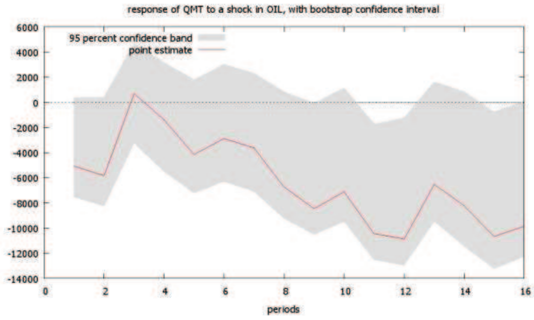


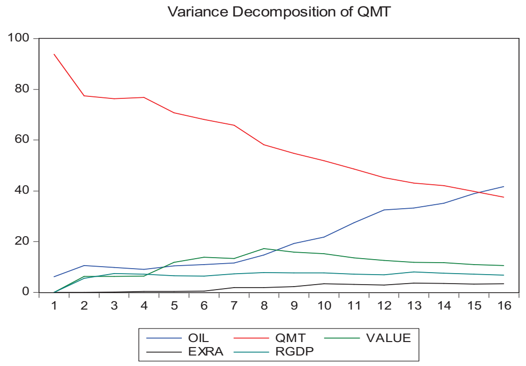
4.1.9 Oceania

4.1.9.1 Australia









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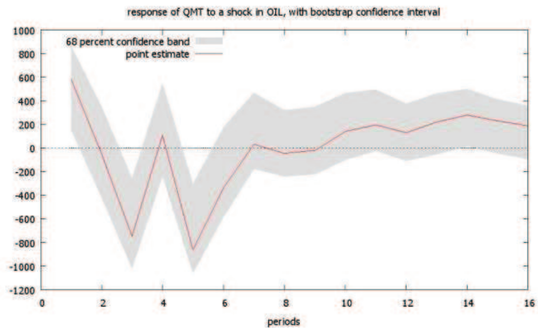
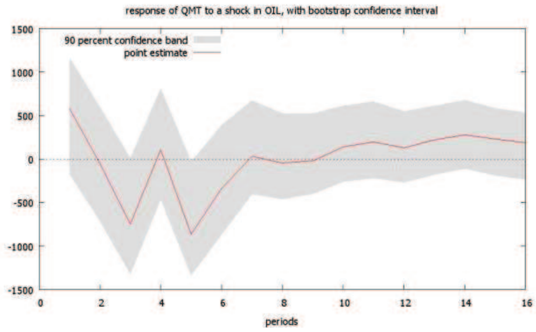
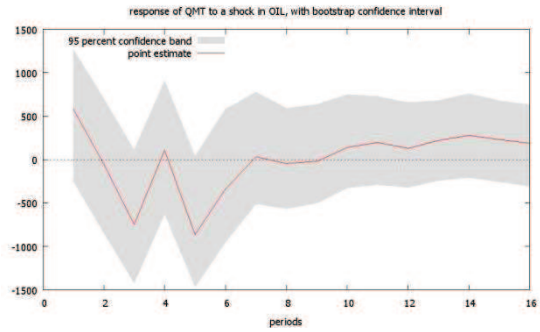
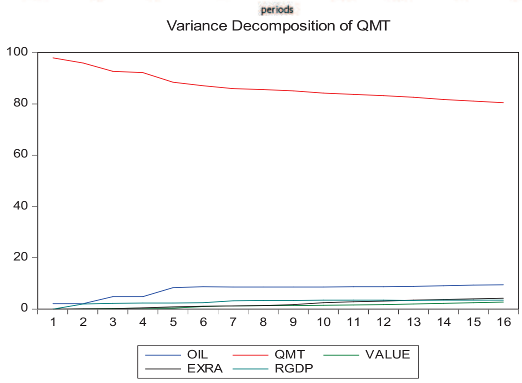






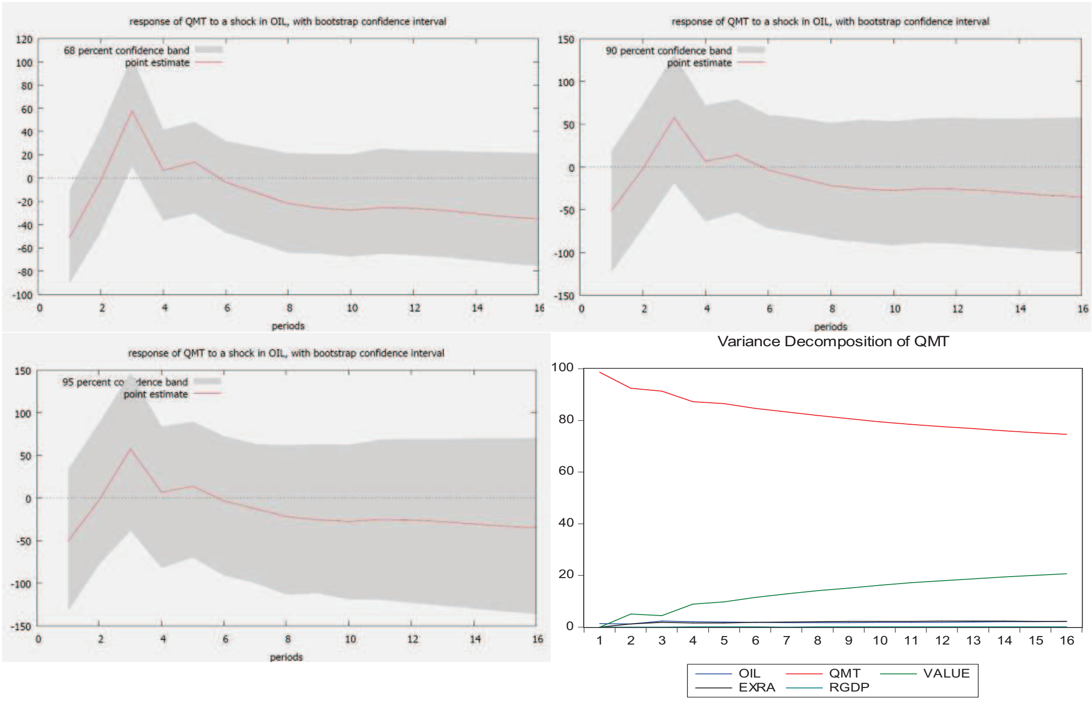


4.2 Steel Export Categories

4.2.1 European Union

4.2.1.1 Belgium

1A



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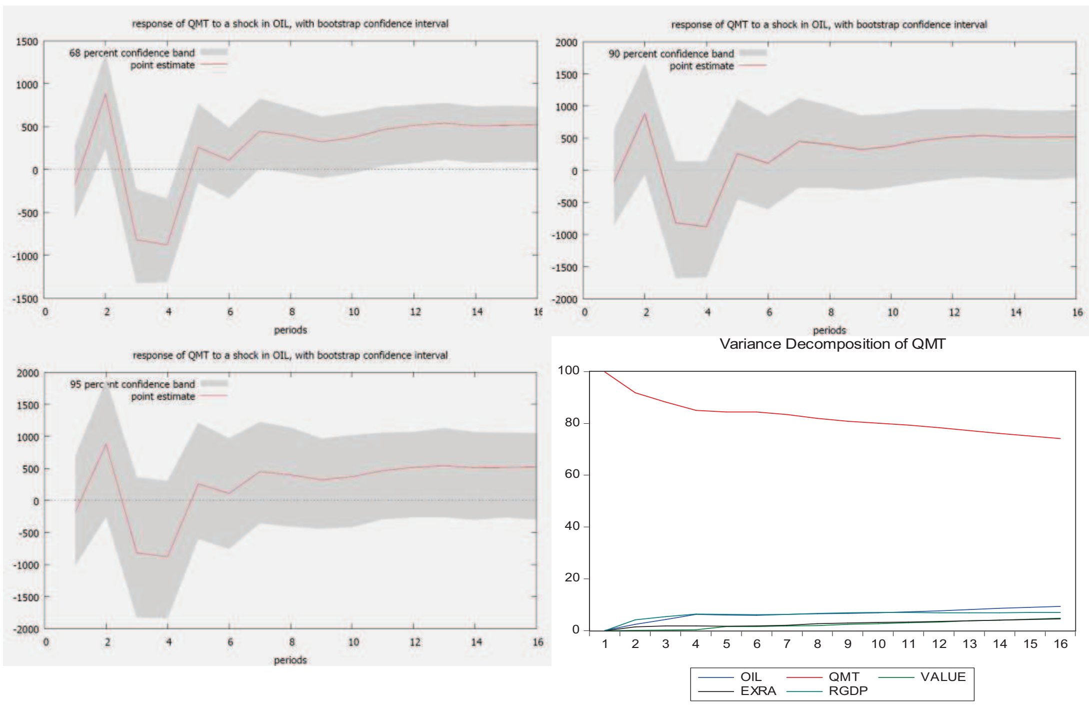

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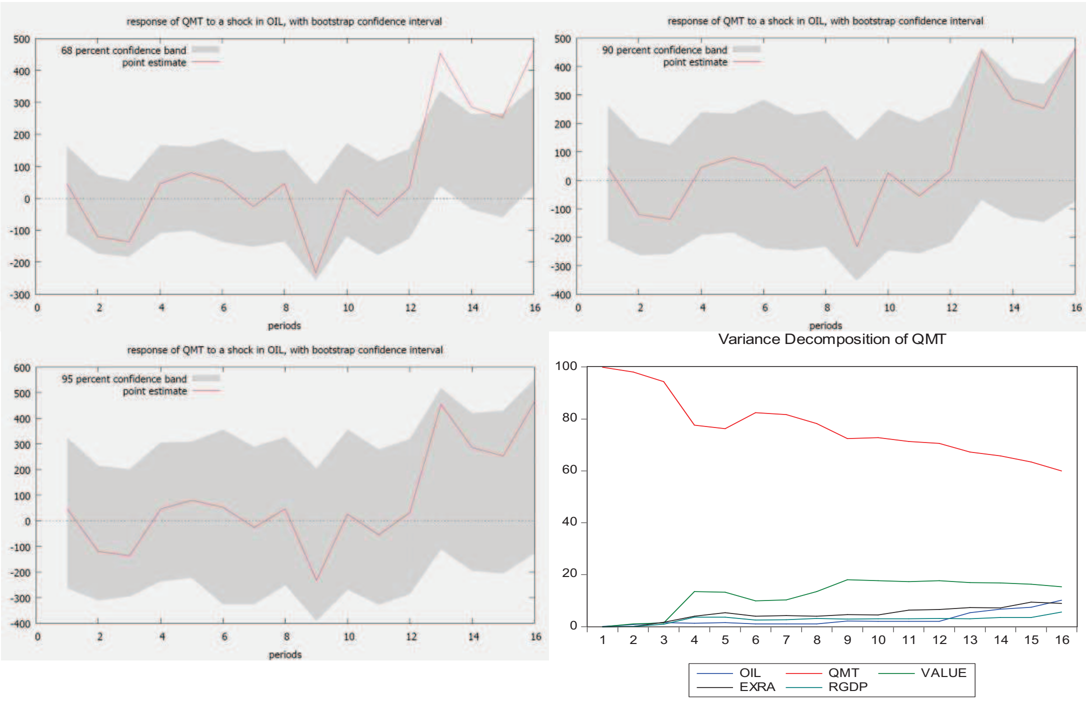
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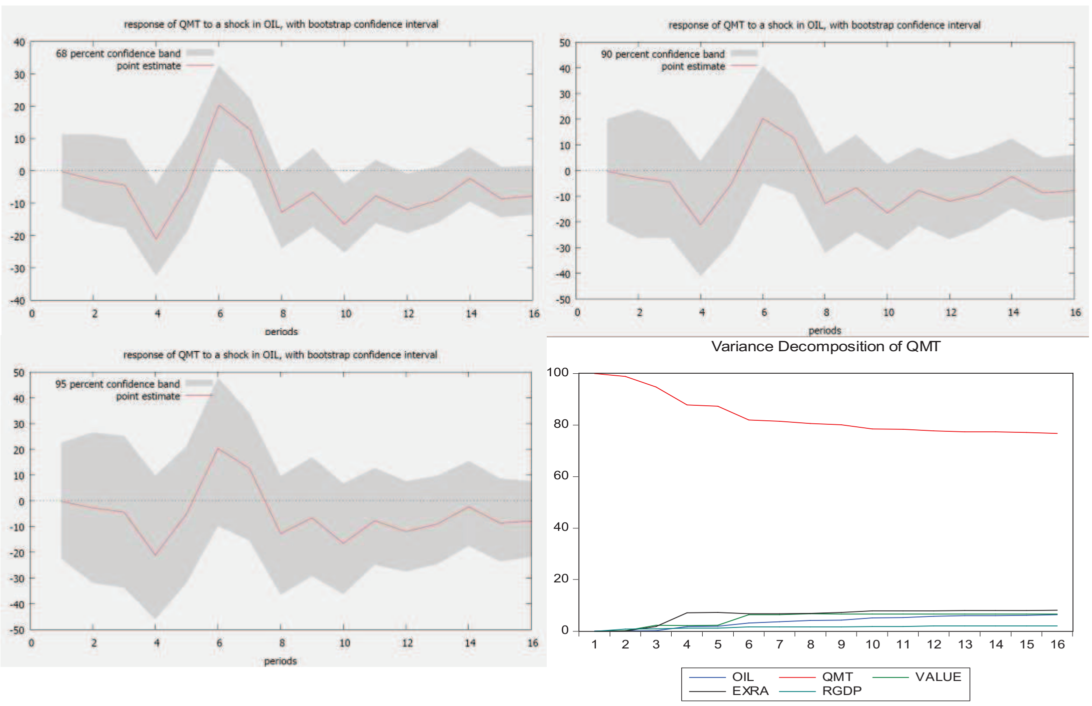
68 percent confidence band
point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
90 percent confidence band
point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
95 percent confidence band
point estimate
periods
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

4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point estimate
periods
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periods
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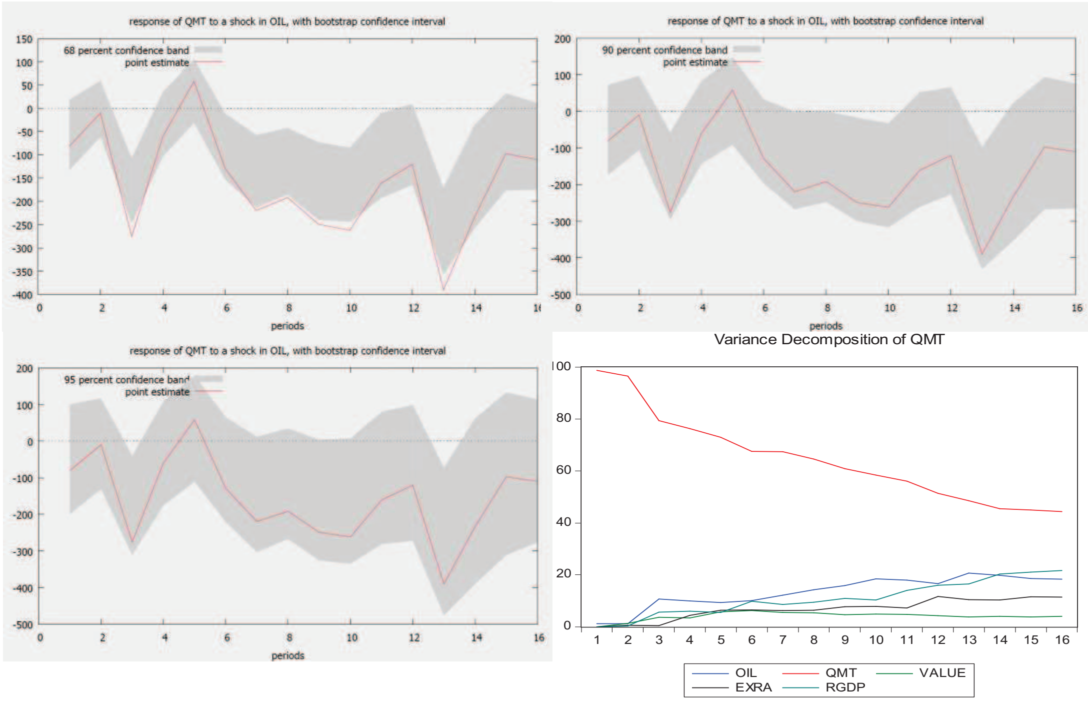
point estimate
periods
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

6A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periods
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periods
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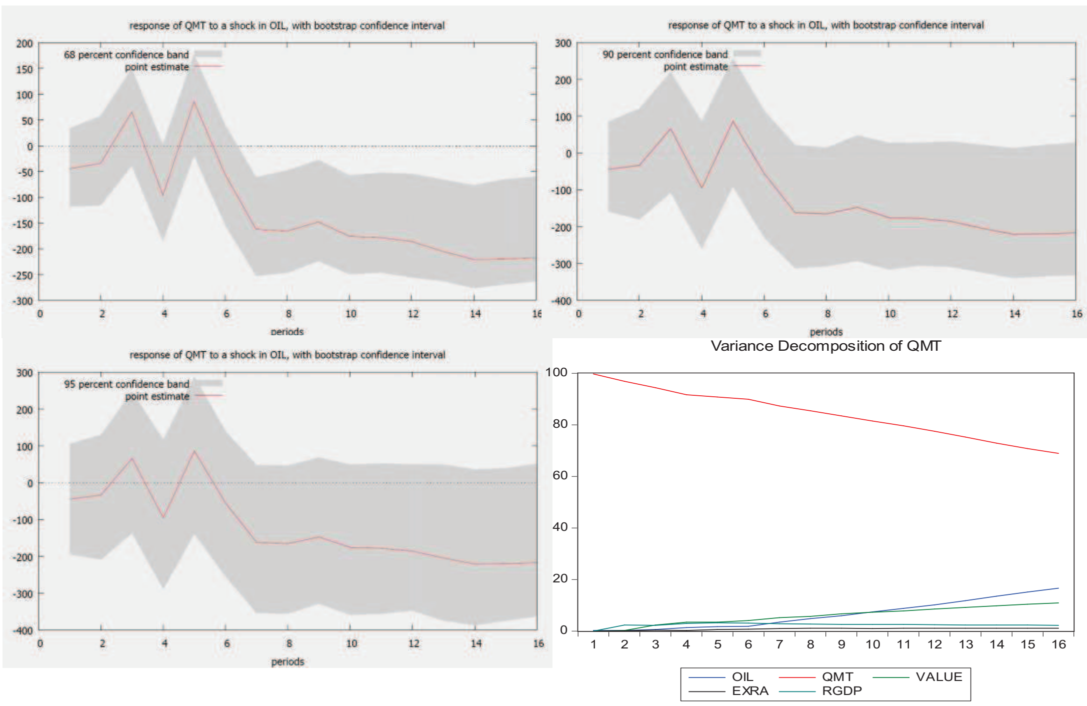
95 percent confidence band
point estimate
periods
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

6B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periods
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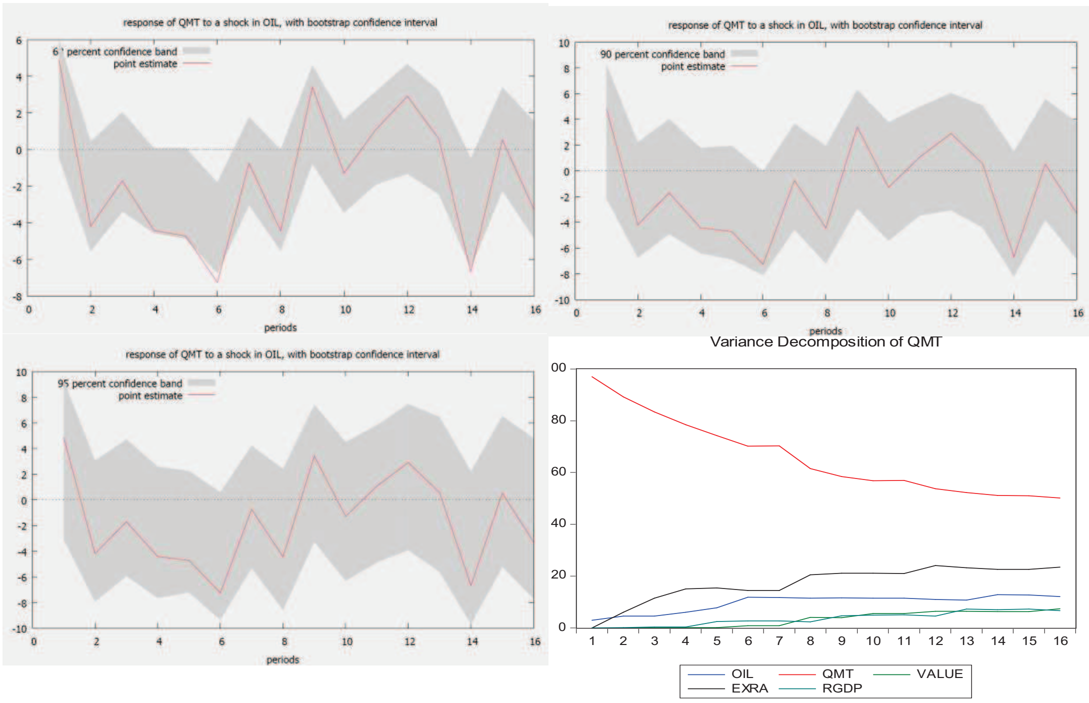
point estimate
periods
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

7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percent confidence band
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90 percent confidence band
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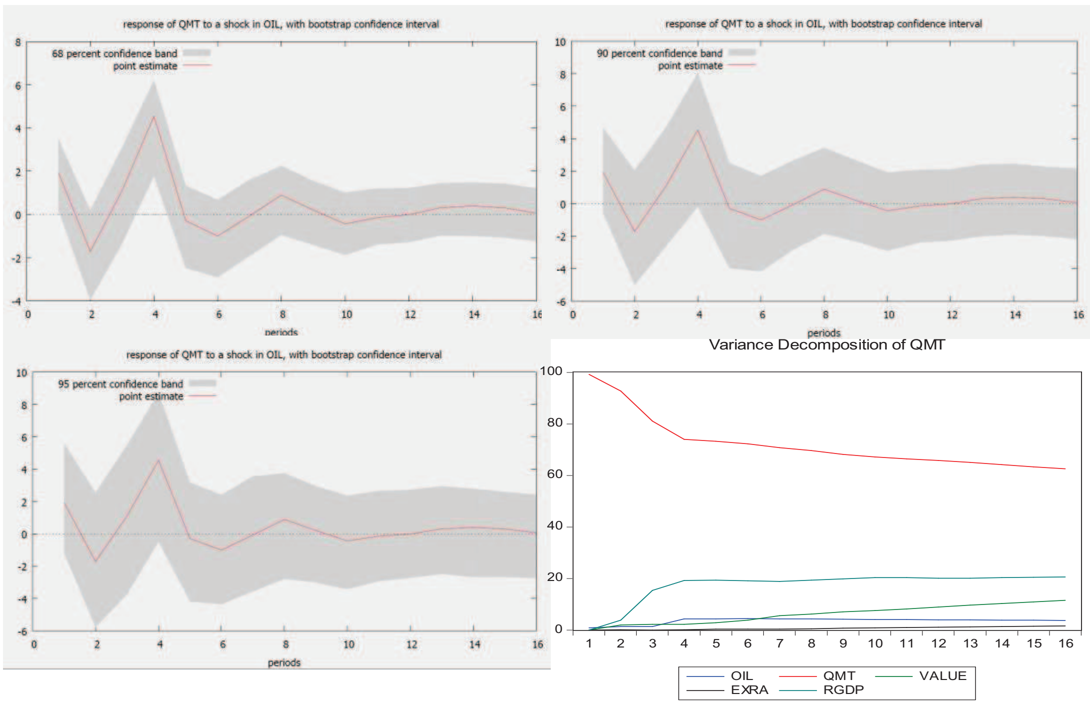
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
95 percent confidence band
point estimate
periods
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

8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periods
response of QMT to a shock in OIL, with bootstrap confidence interval
90 percent confidence band
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periods
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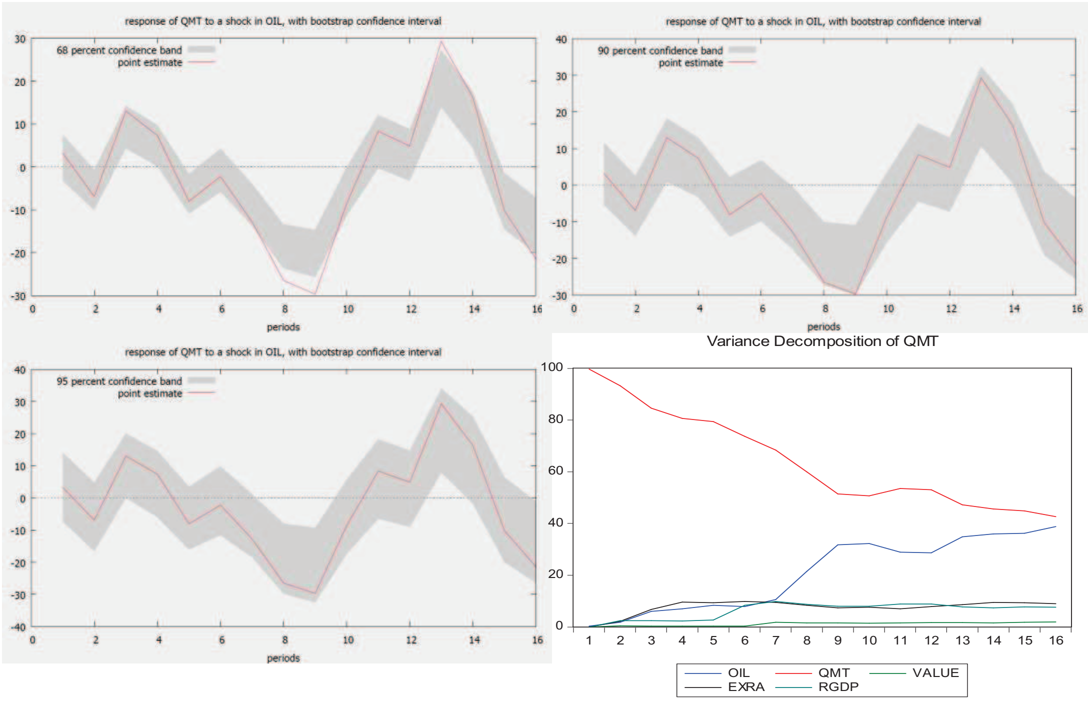
95 percent confidence band
point estimate
periods
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

14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periods
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90 percent confidence band
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periods
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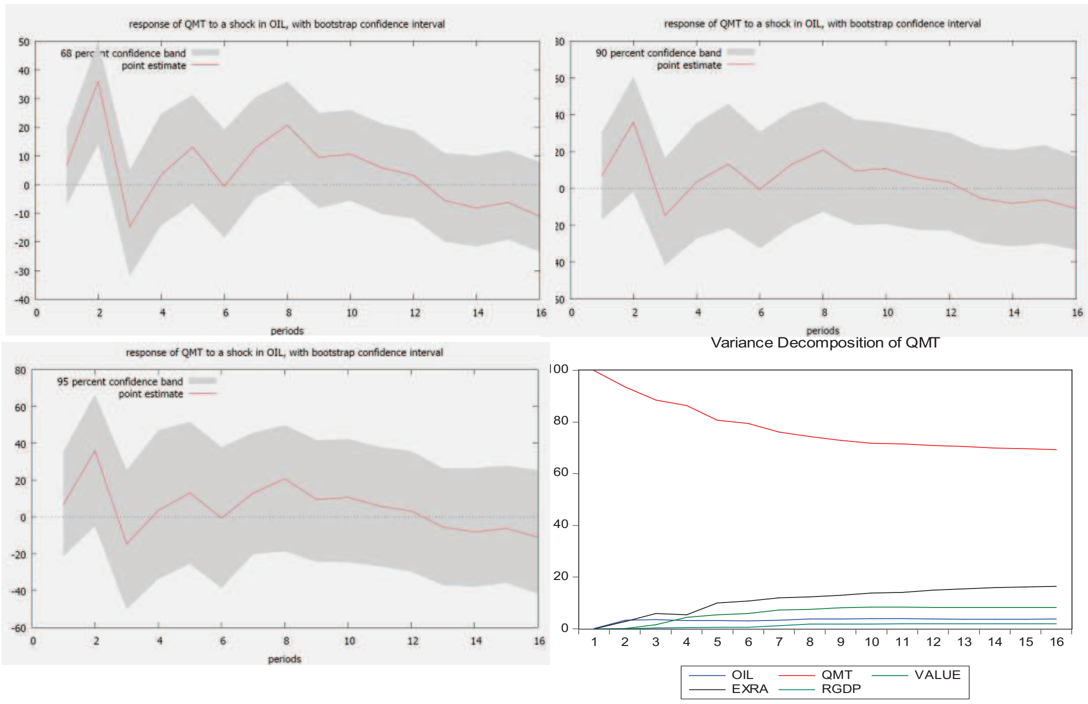
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

14A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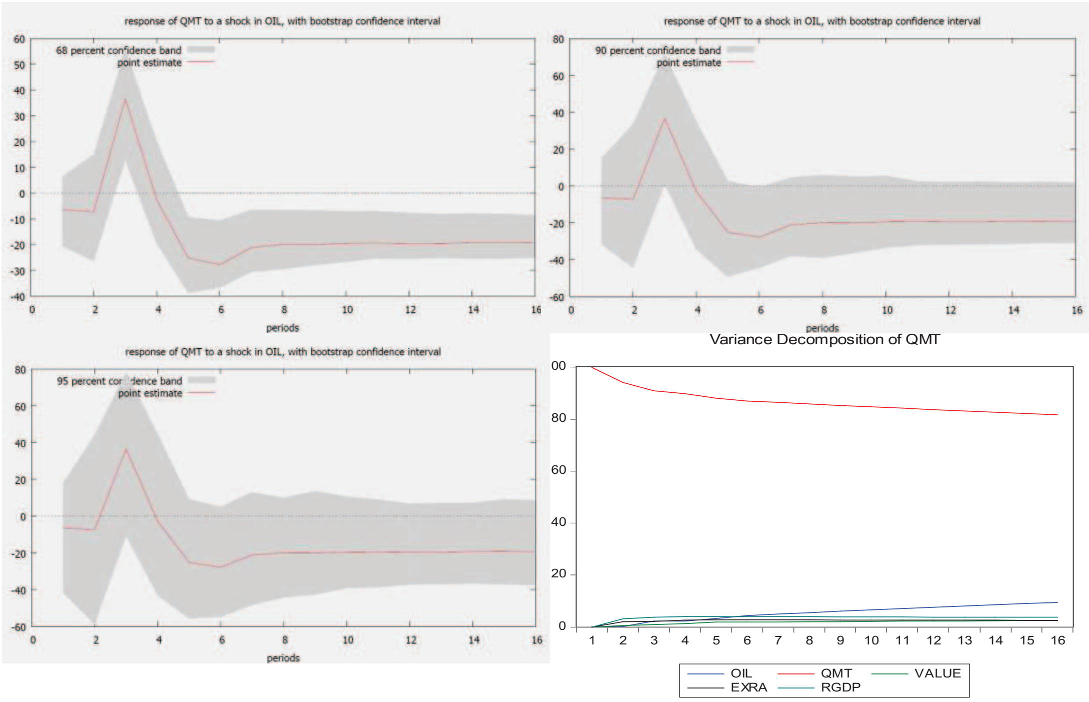
95 percent confidence band
point estimate
periods
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

15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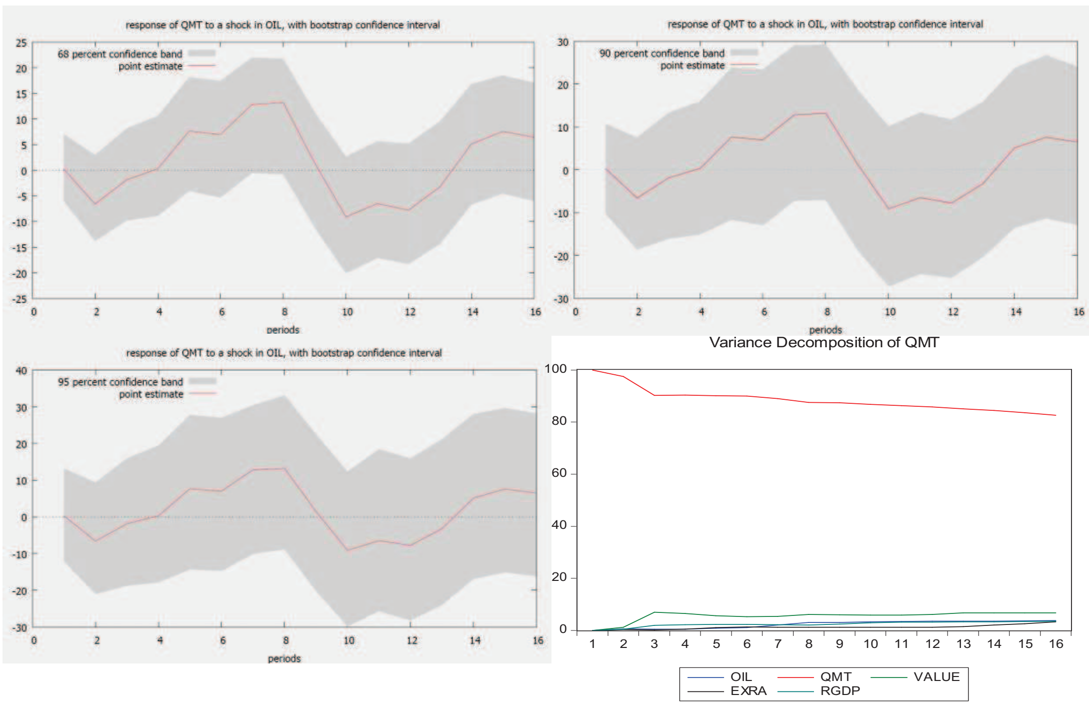
95 percent confidence band
point estimate
periods
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

16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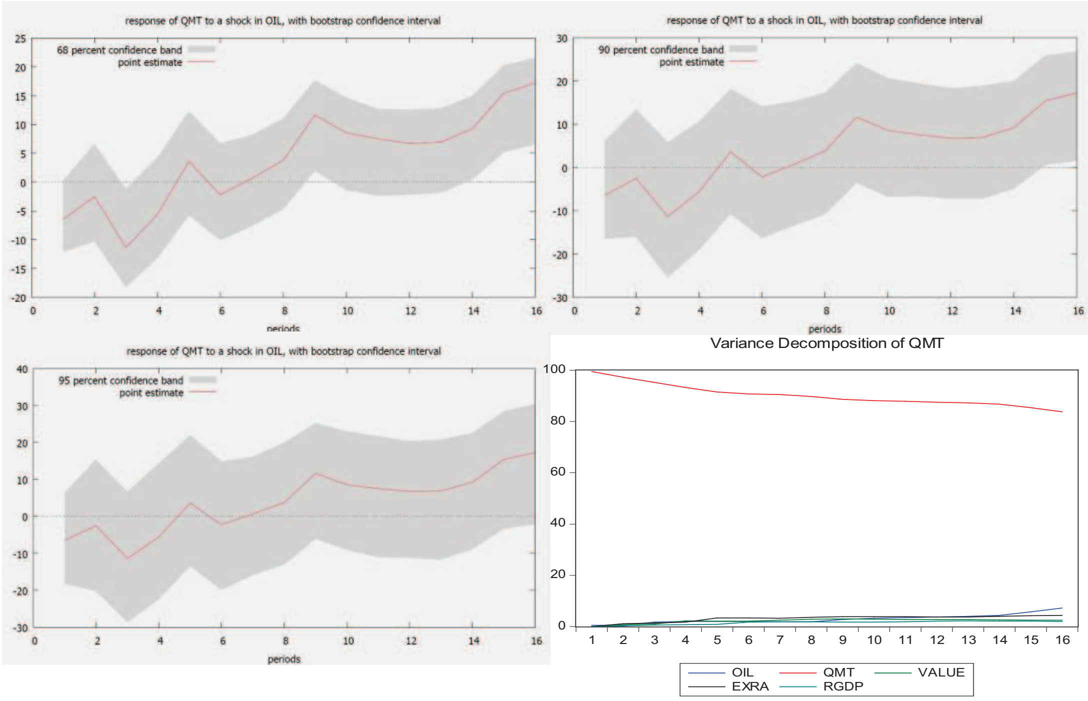
95 percent confidence band
point estimate
periods
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

17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point estimate
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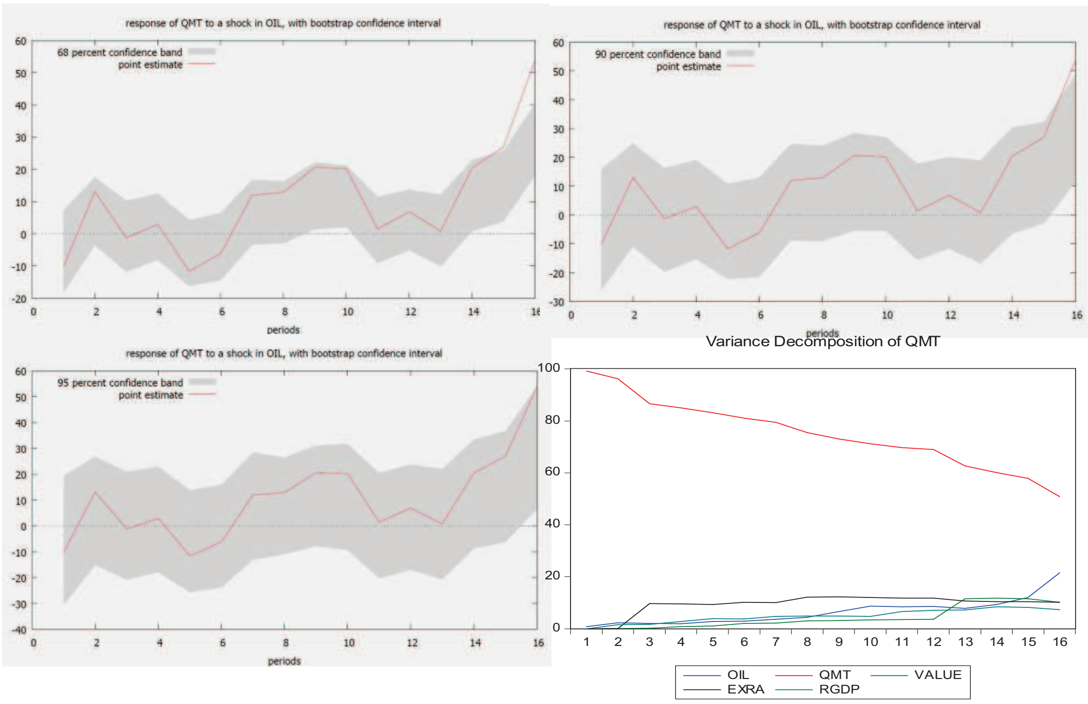
response of QMT to a shock in OIL, with bootstrap confidence interval
95 percent confidence band
point estimate
periods
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

18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point estimate
periods
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95 percent confidence band
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Variance Decomposition of QMT
OIL
QMT
VALUE
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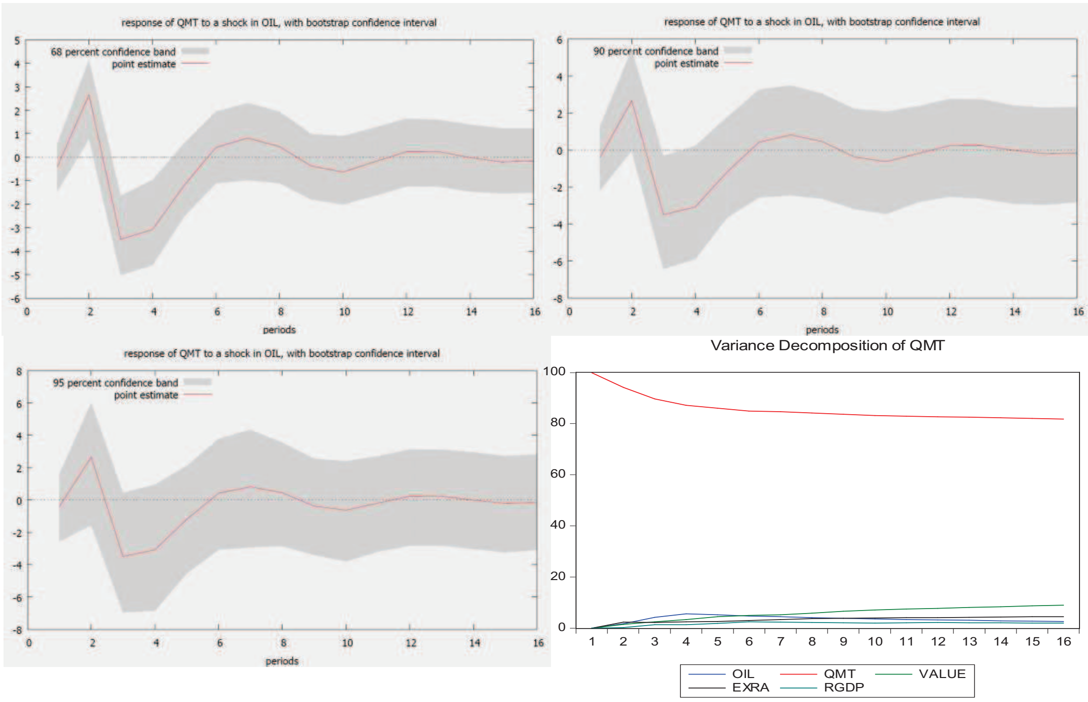
RGDP

19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OIL
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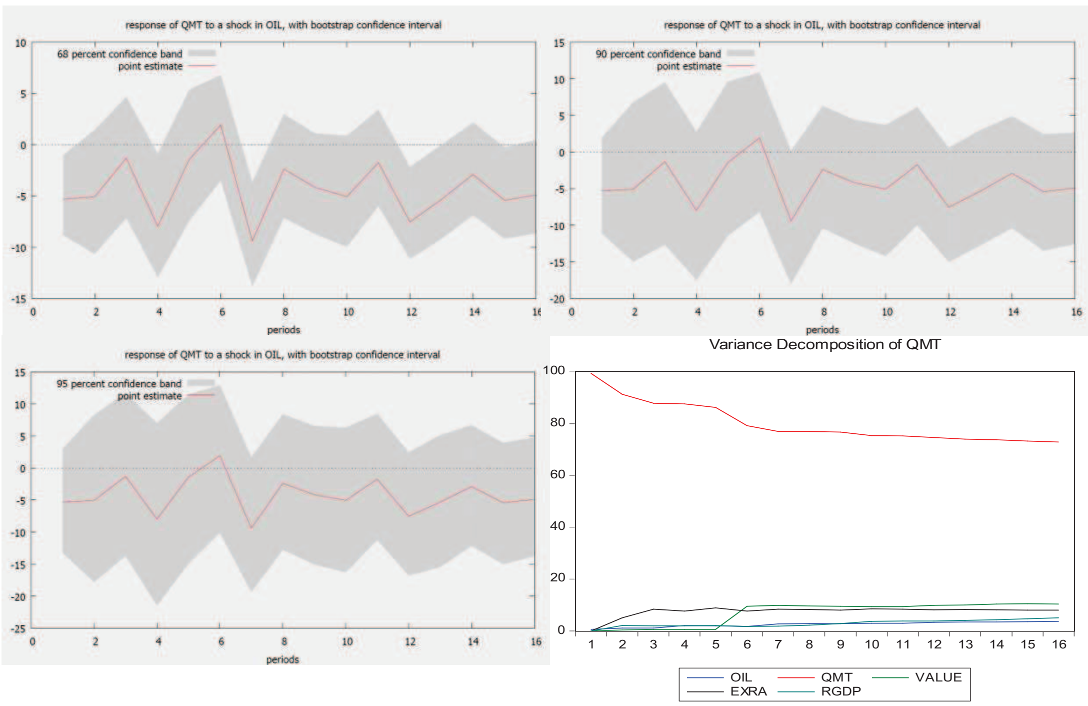
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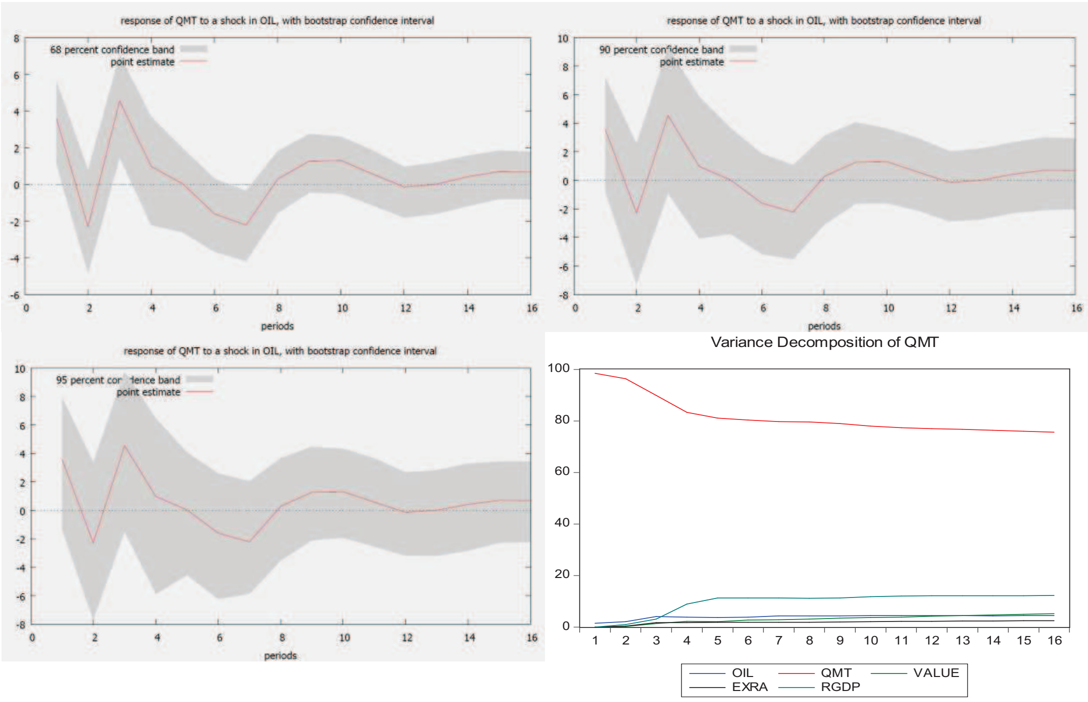
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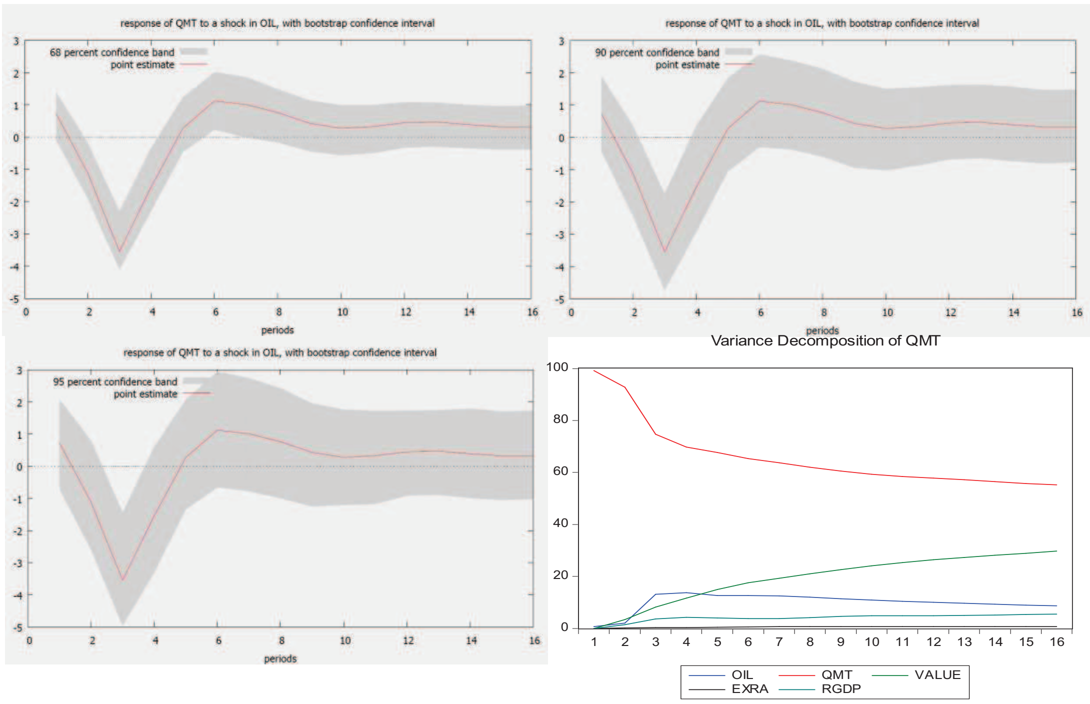
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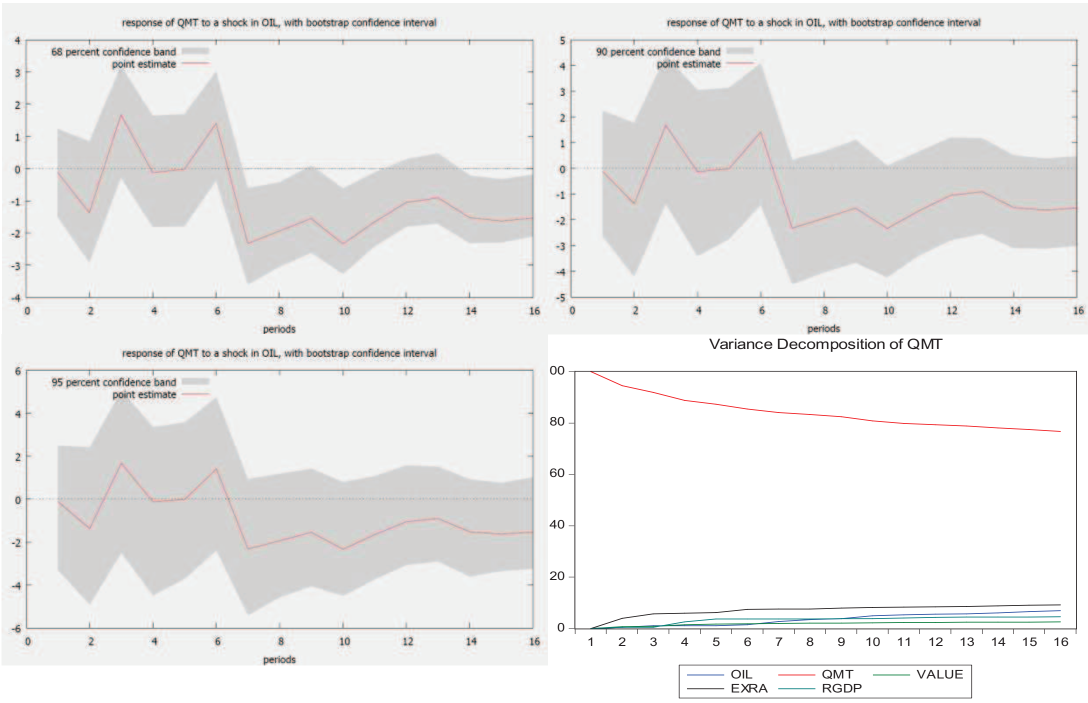
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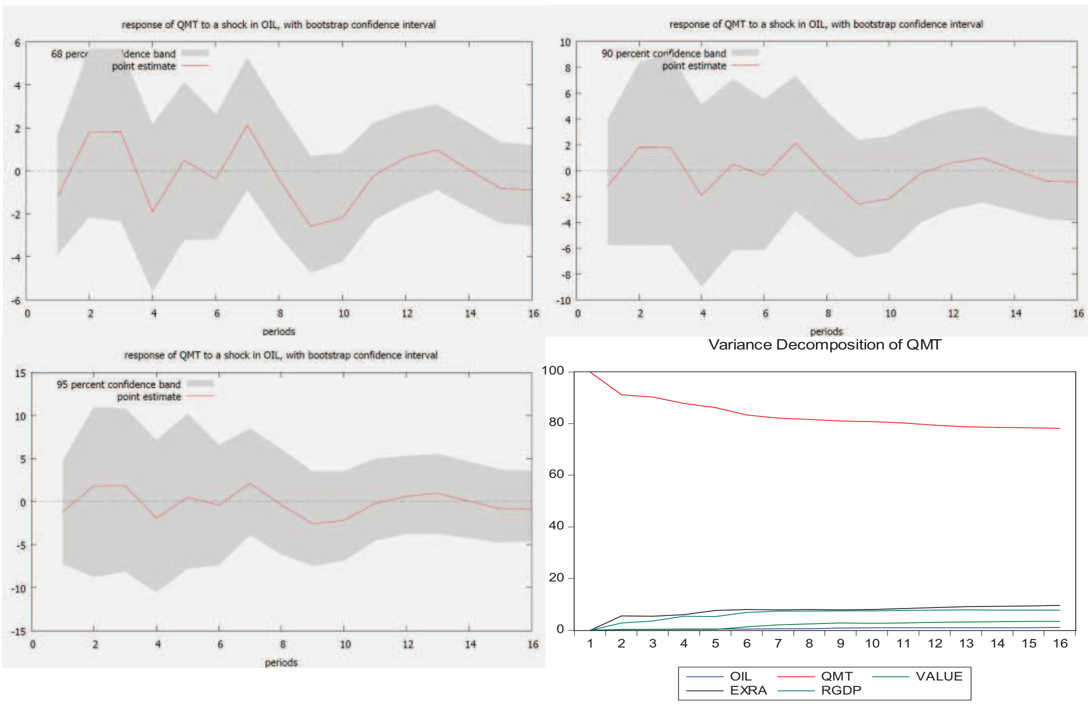
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RGDP

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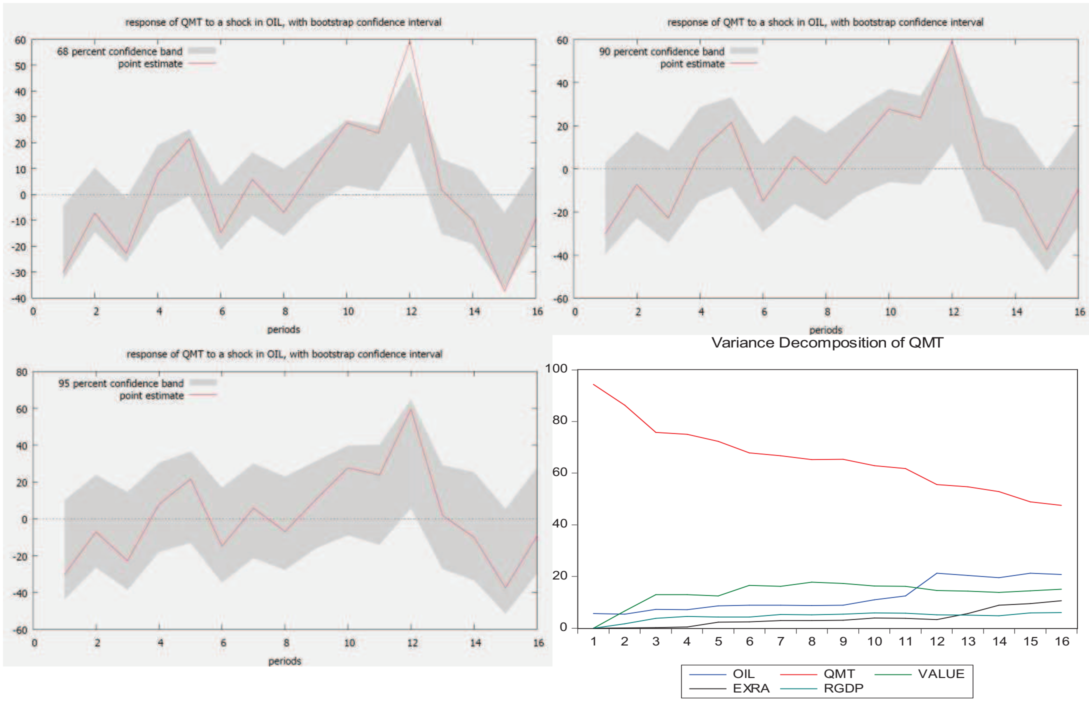
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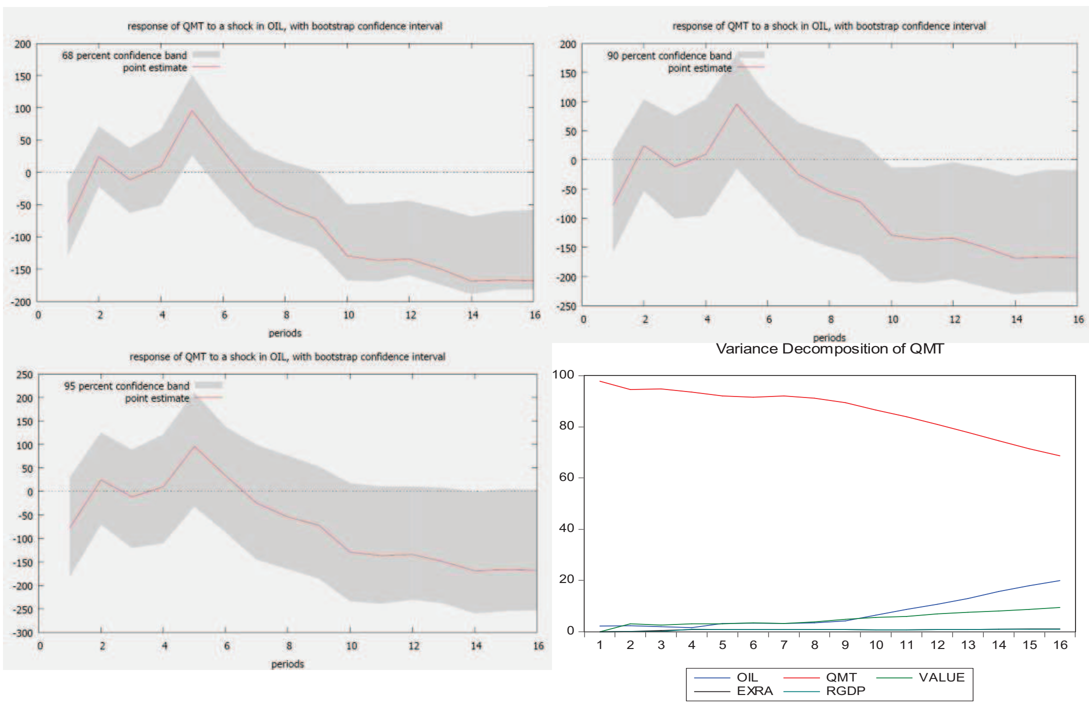
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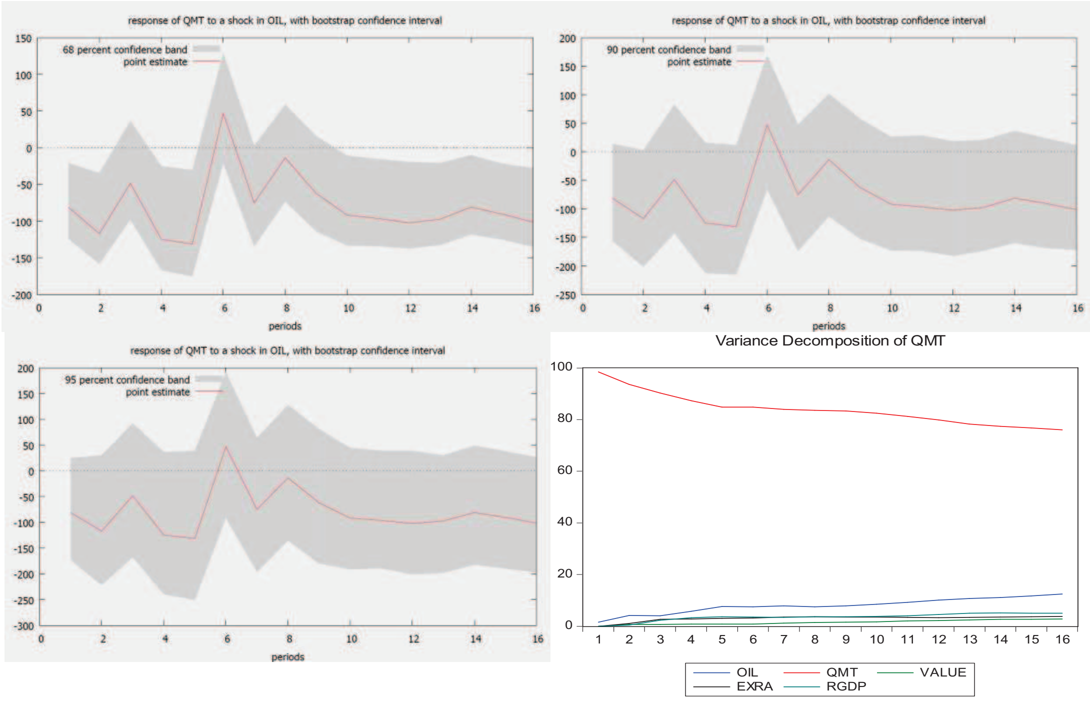
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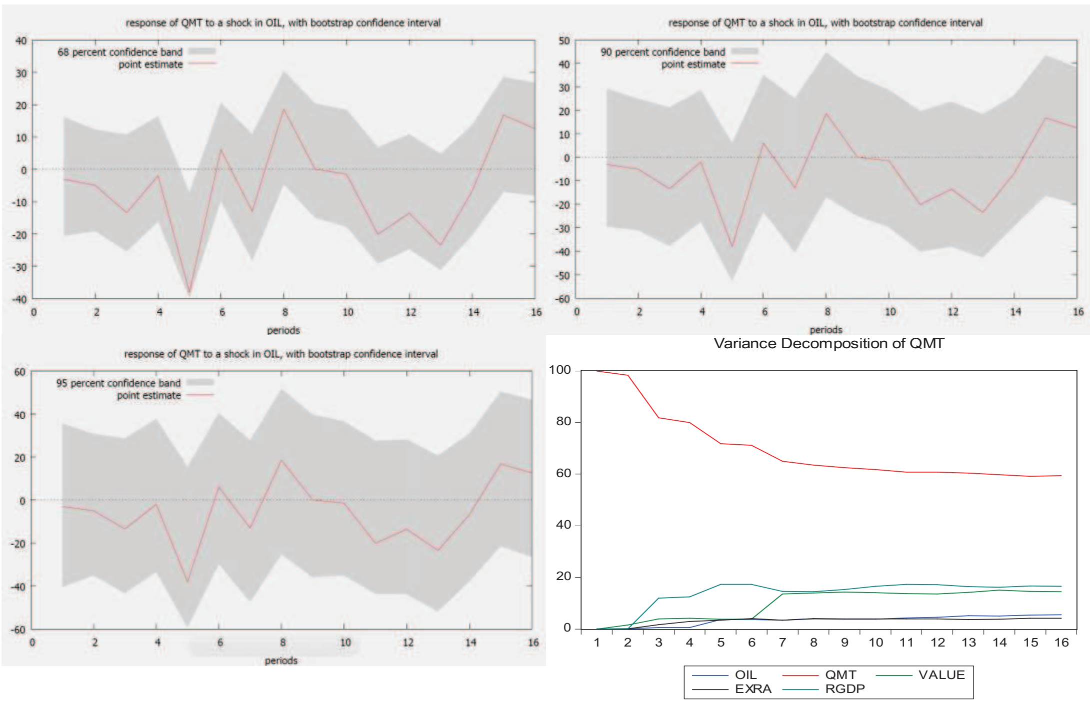
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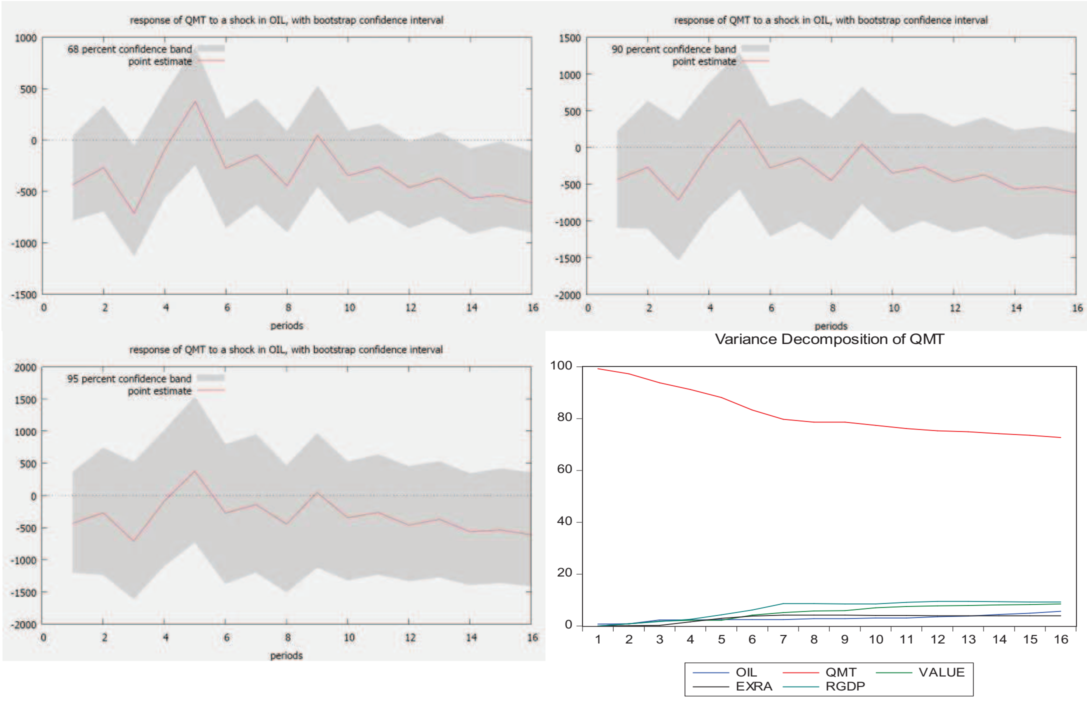
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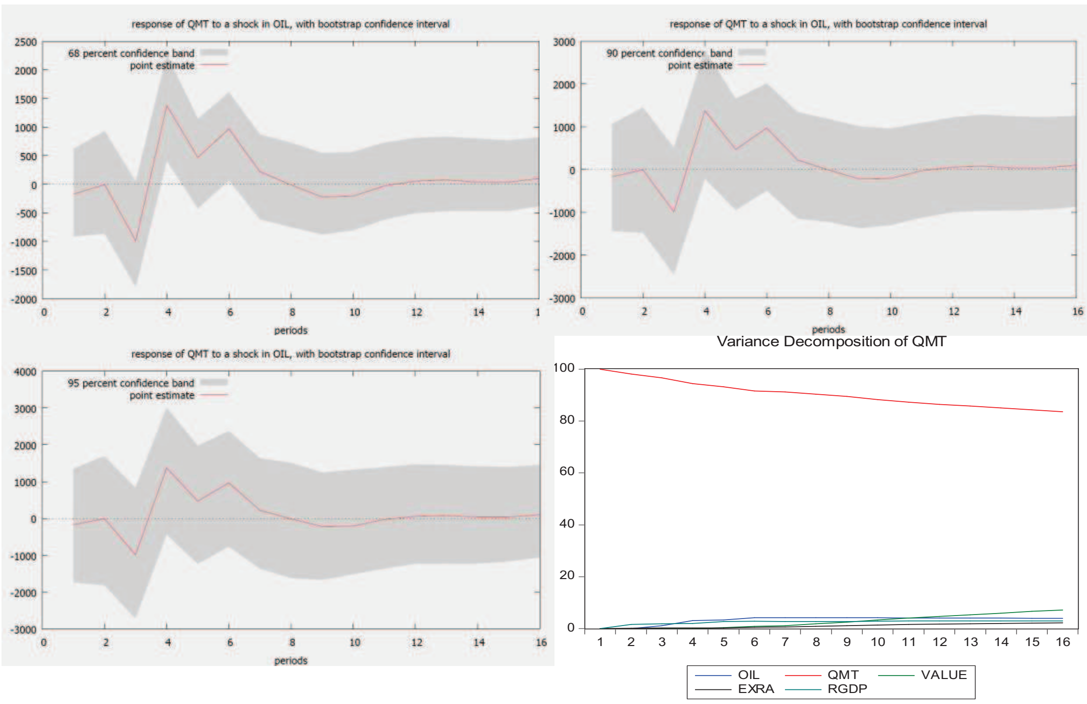
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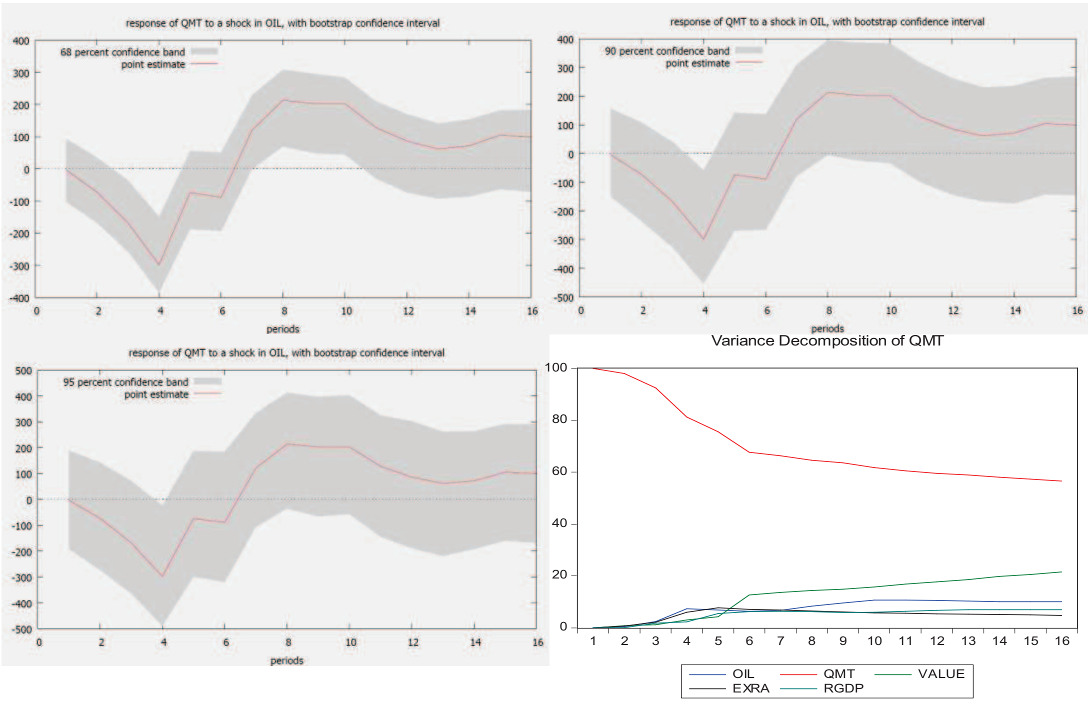
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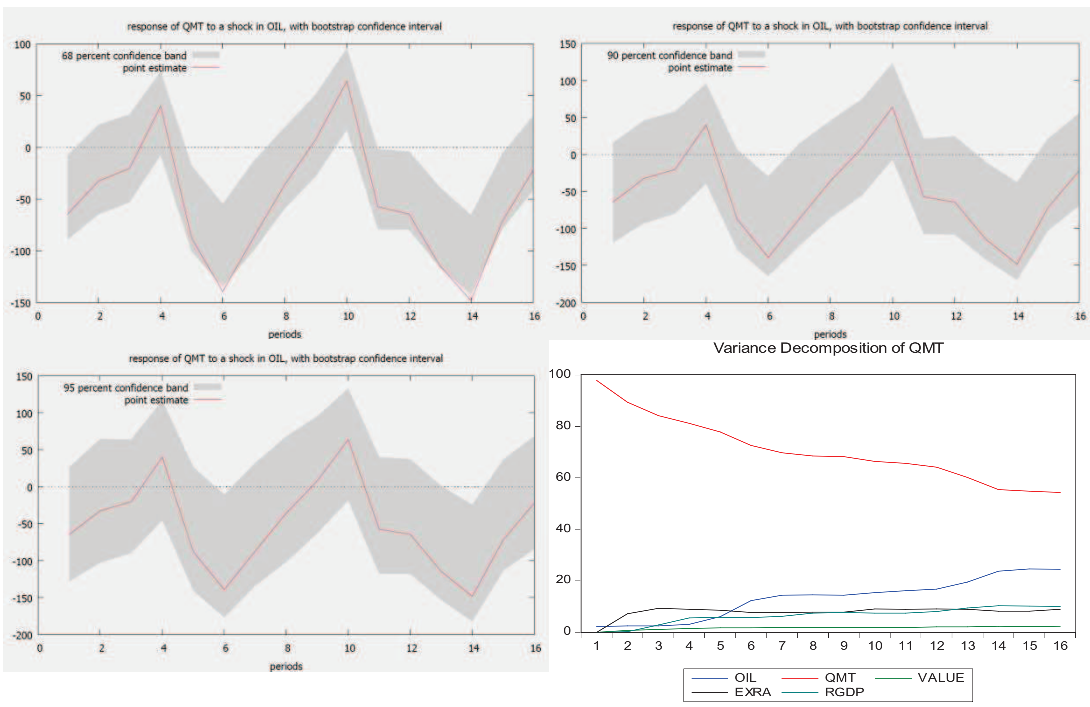
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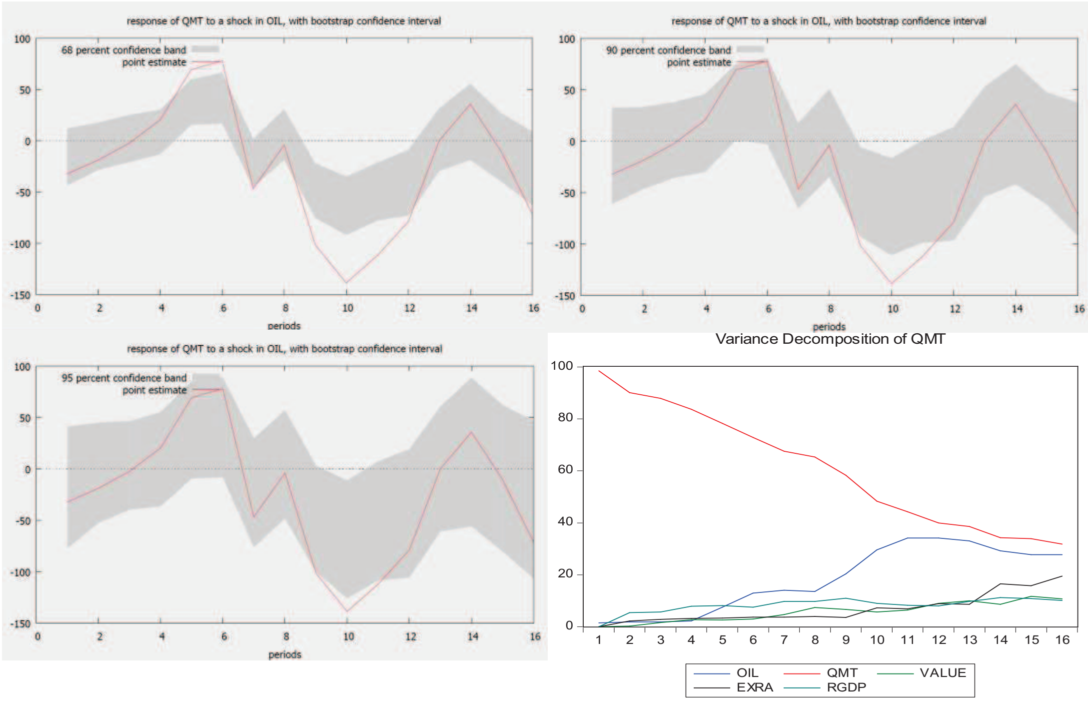
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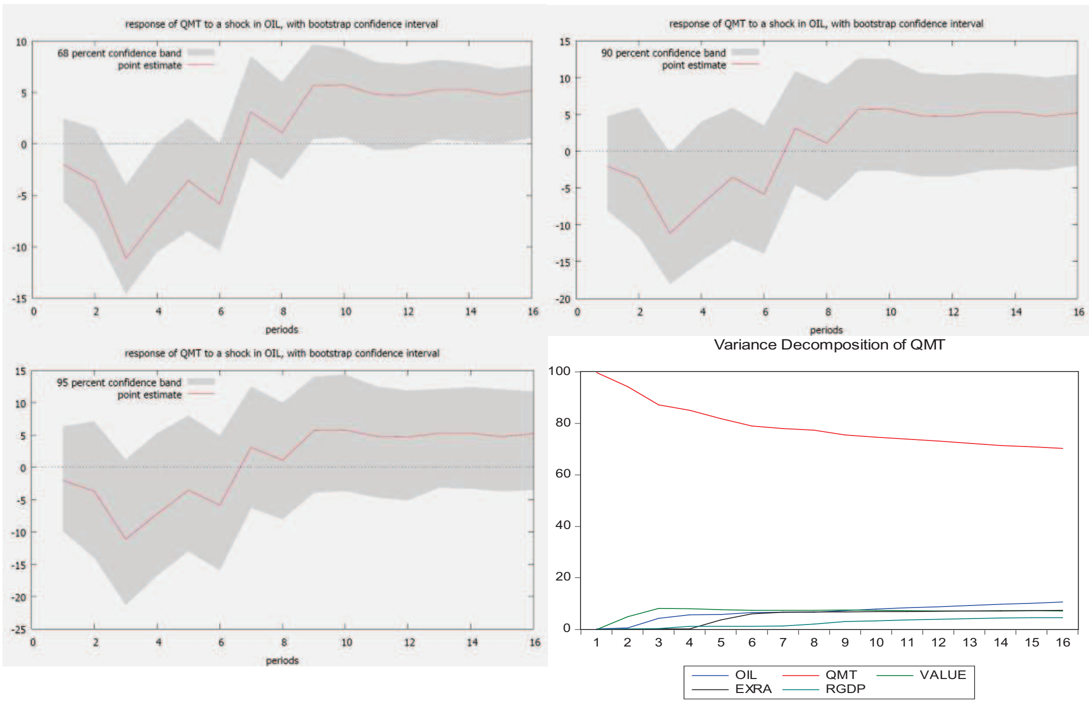
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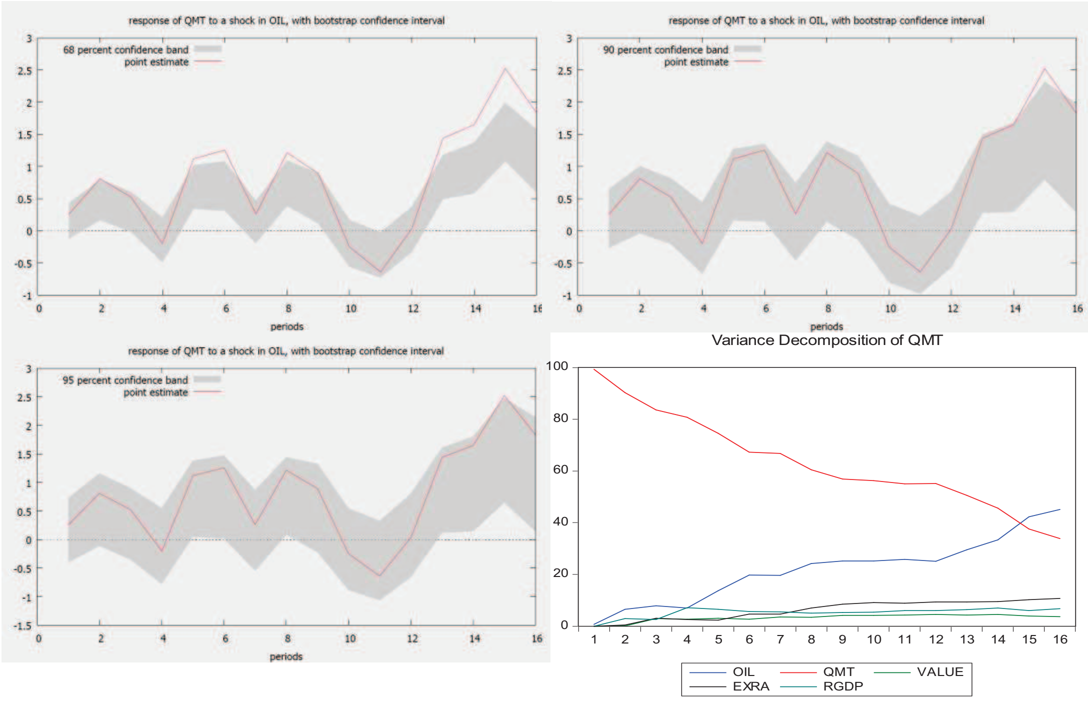
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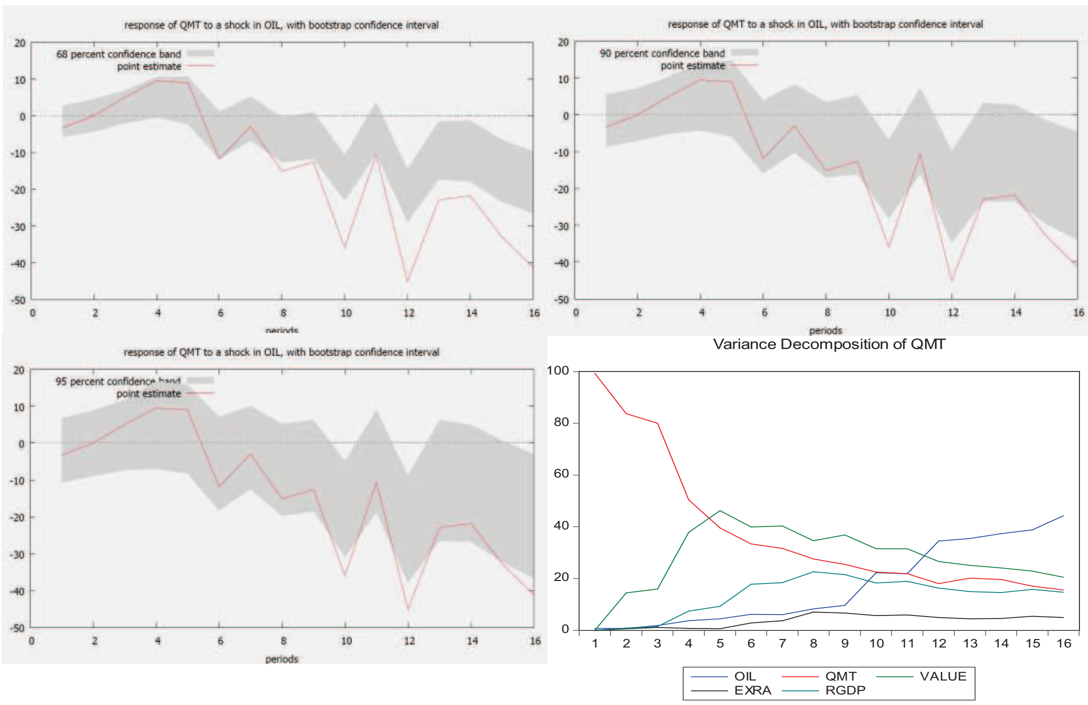
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4.2.1.2 France

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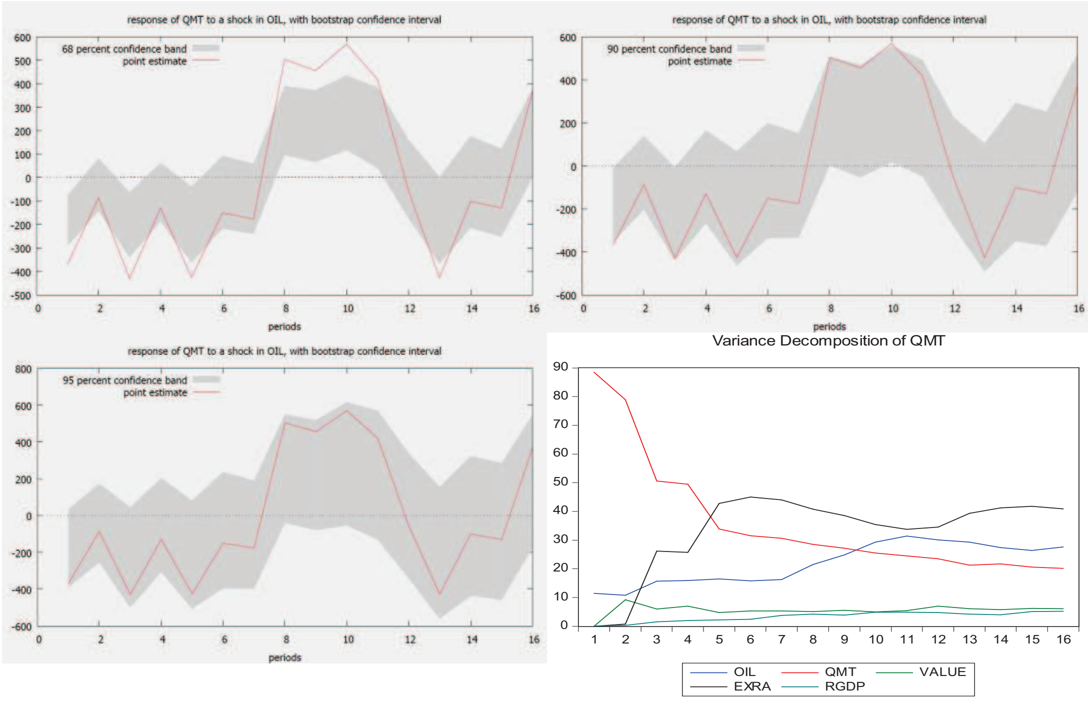

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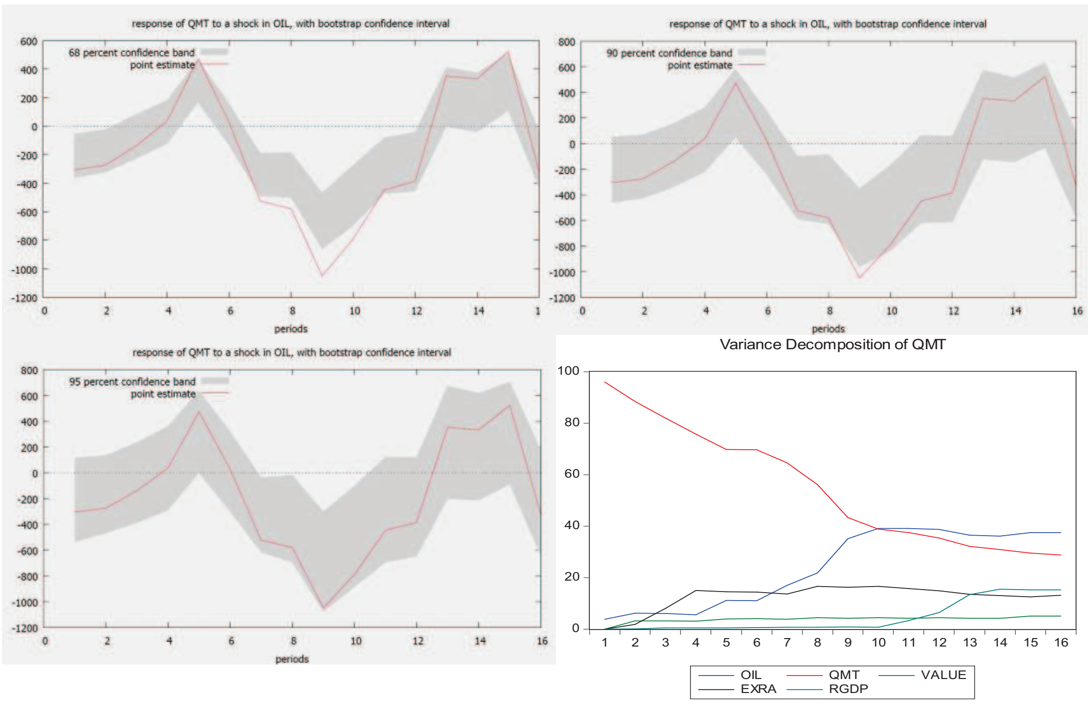

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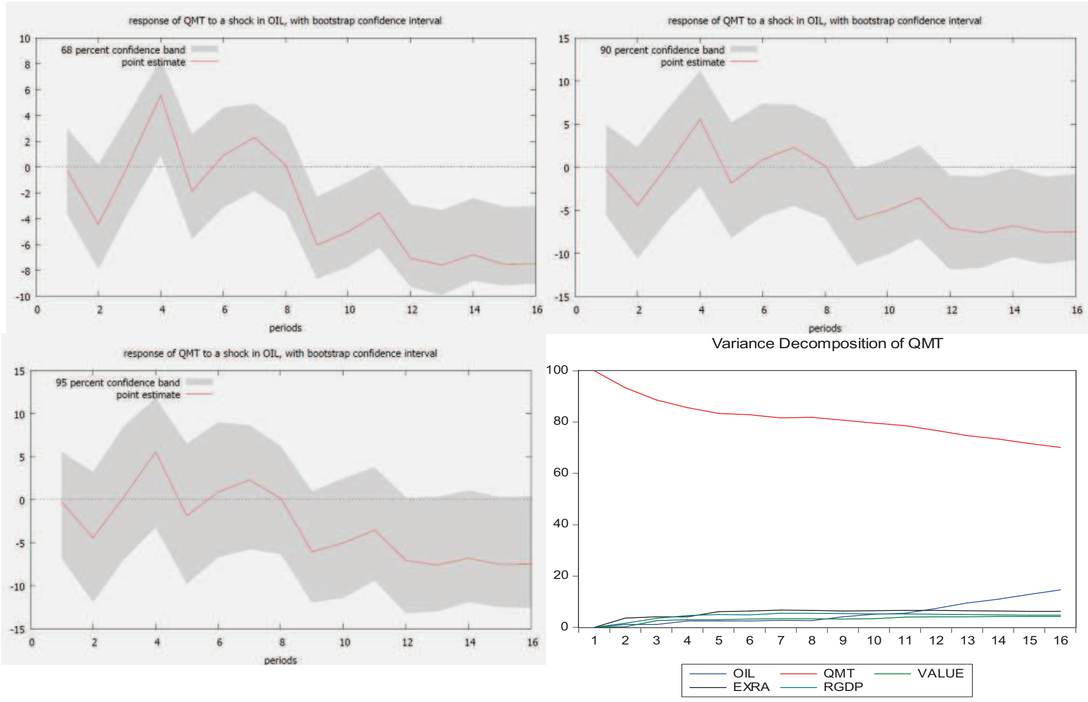
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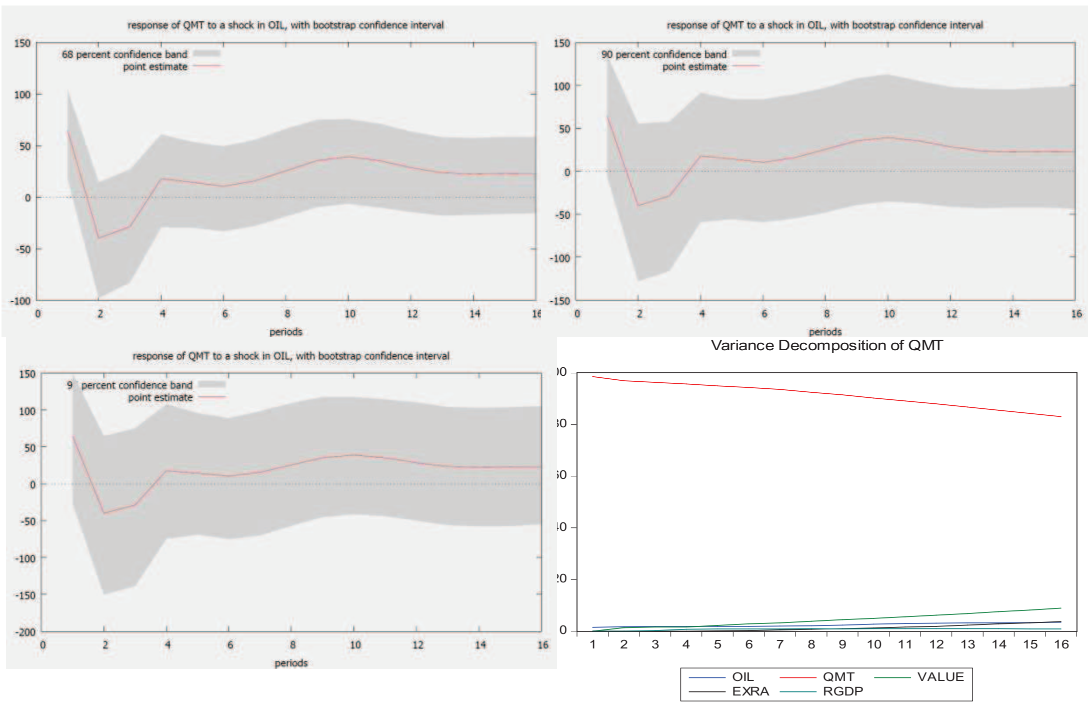
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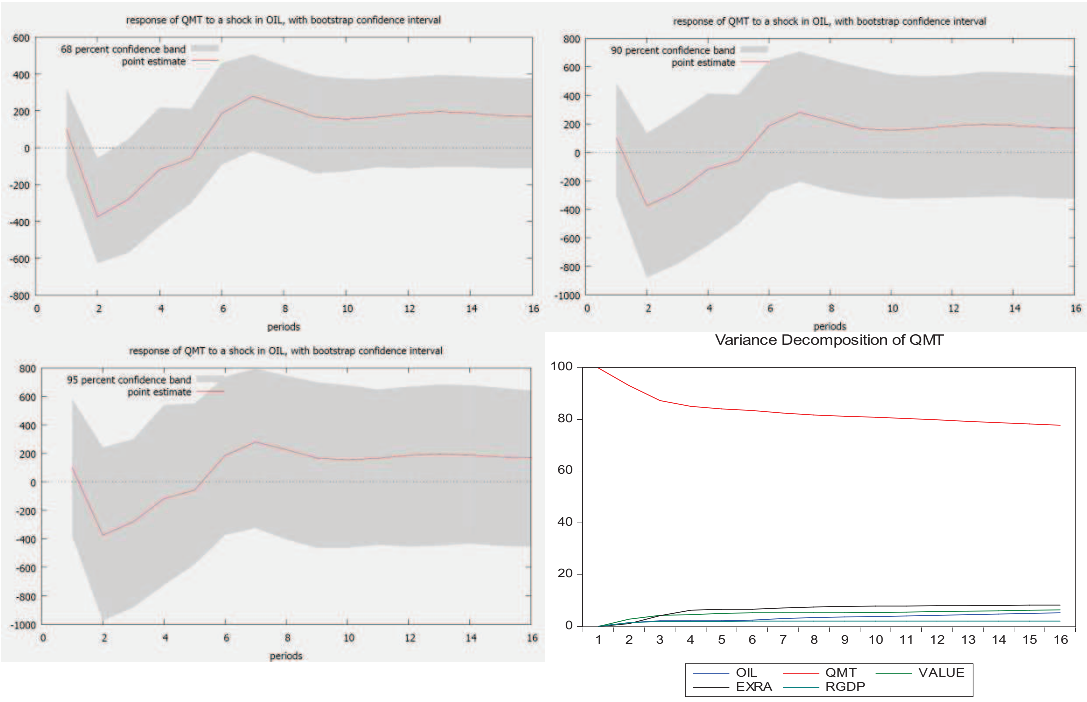
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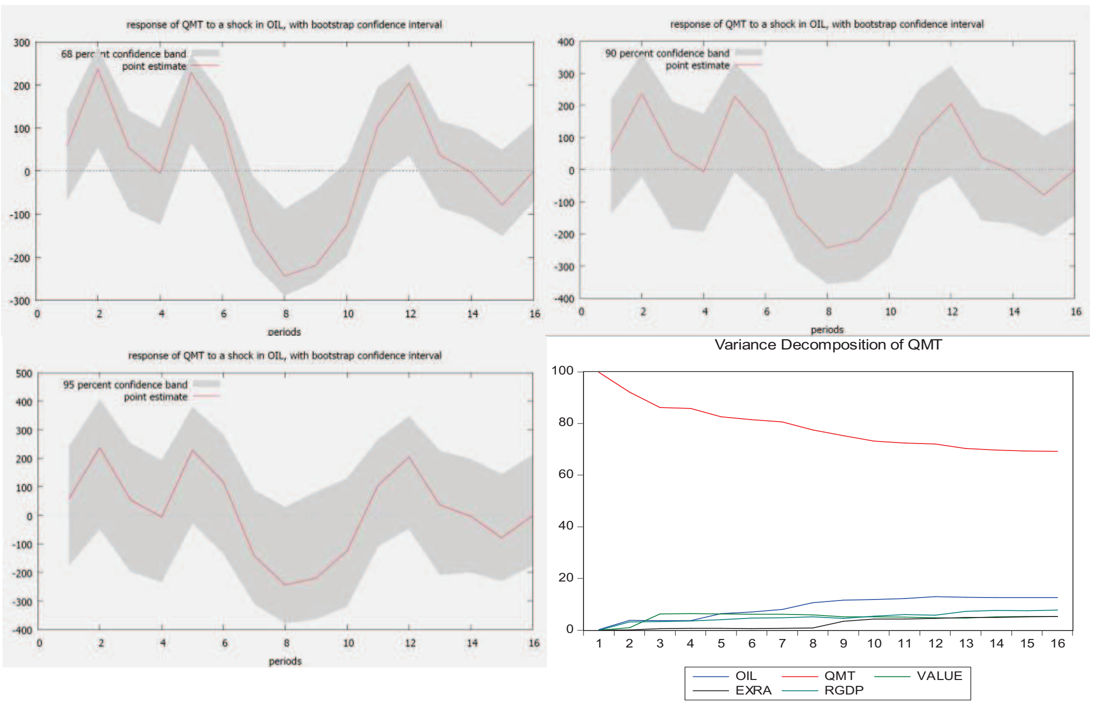
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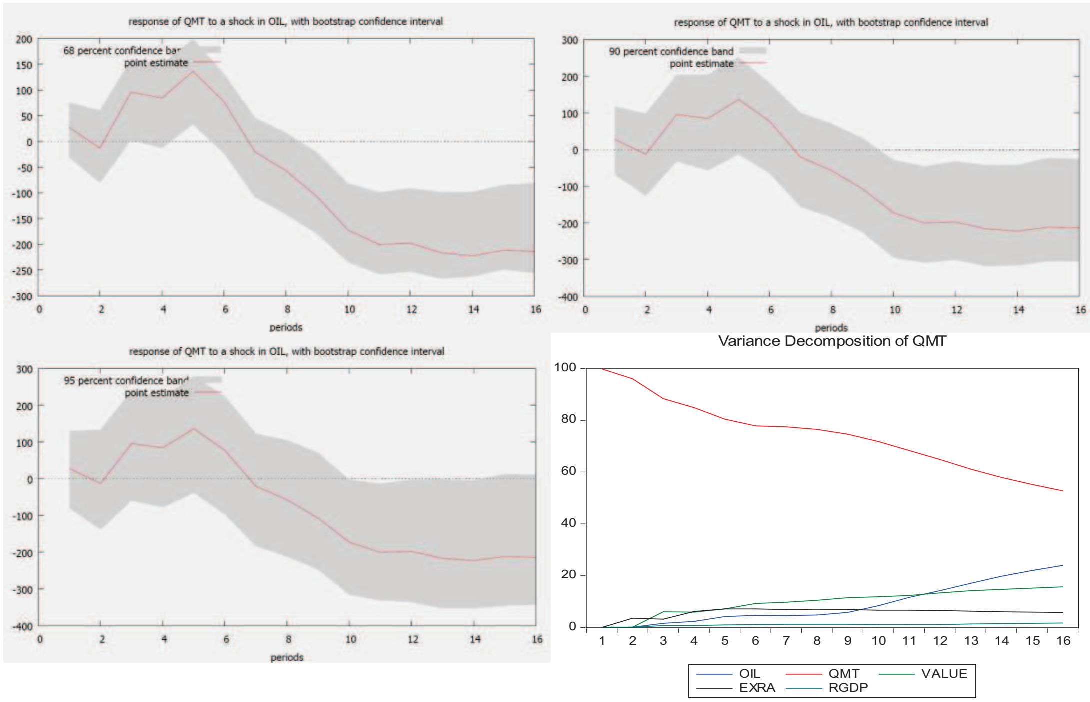
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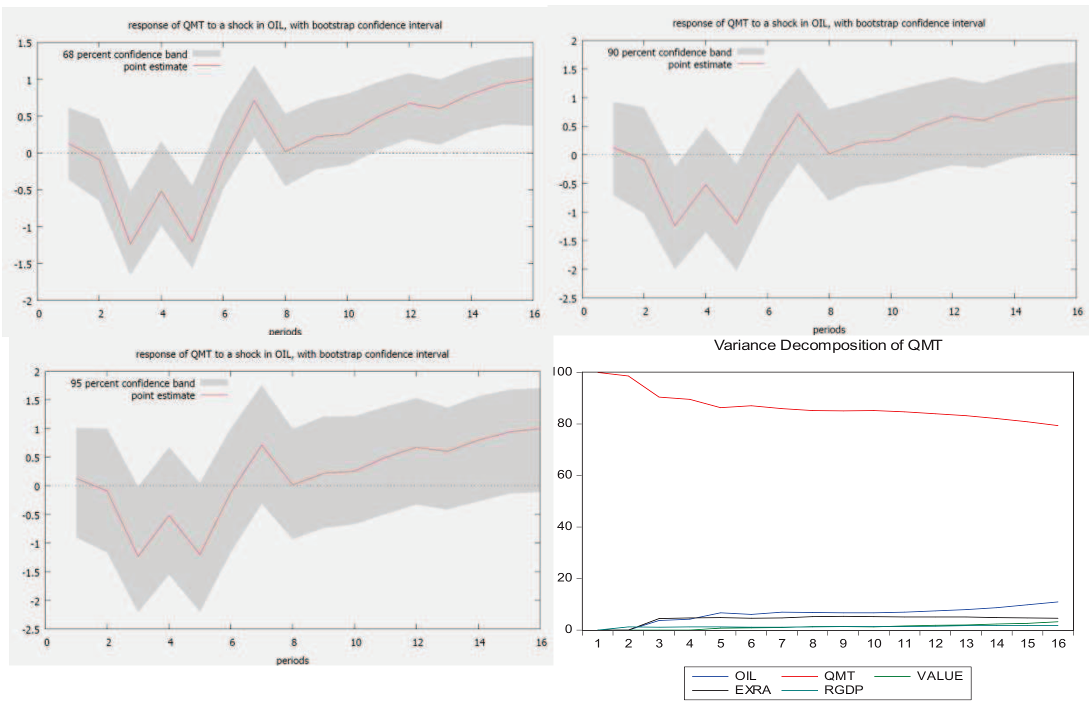
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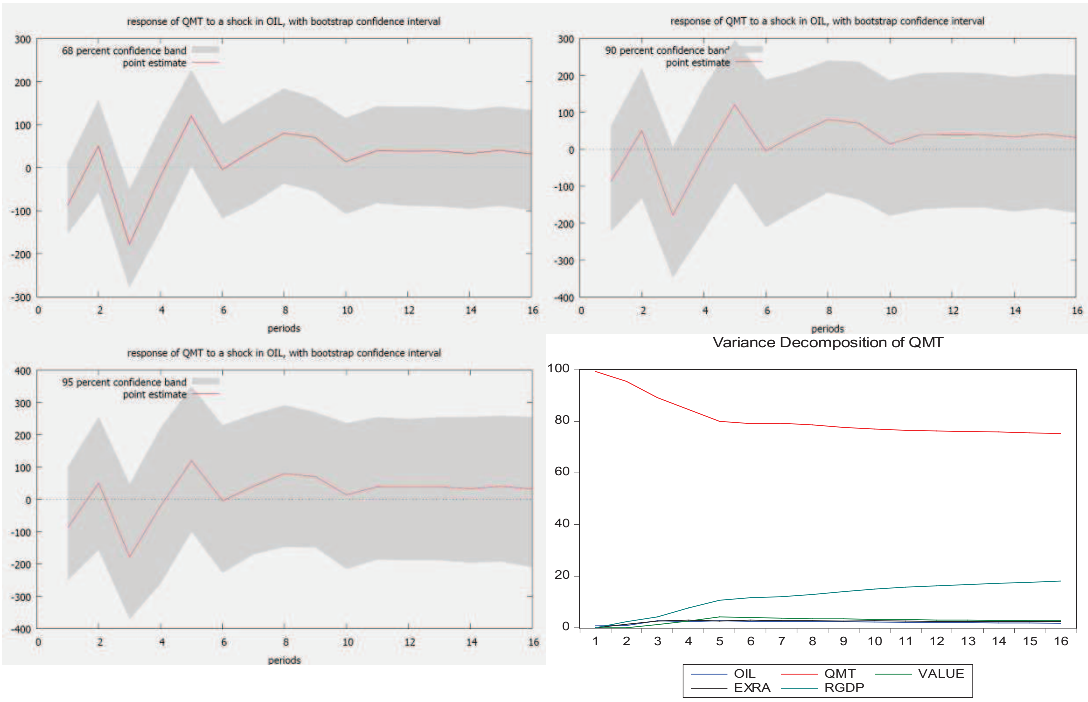
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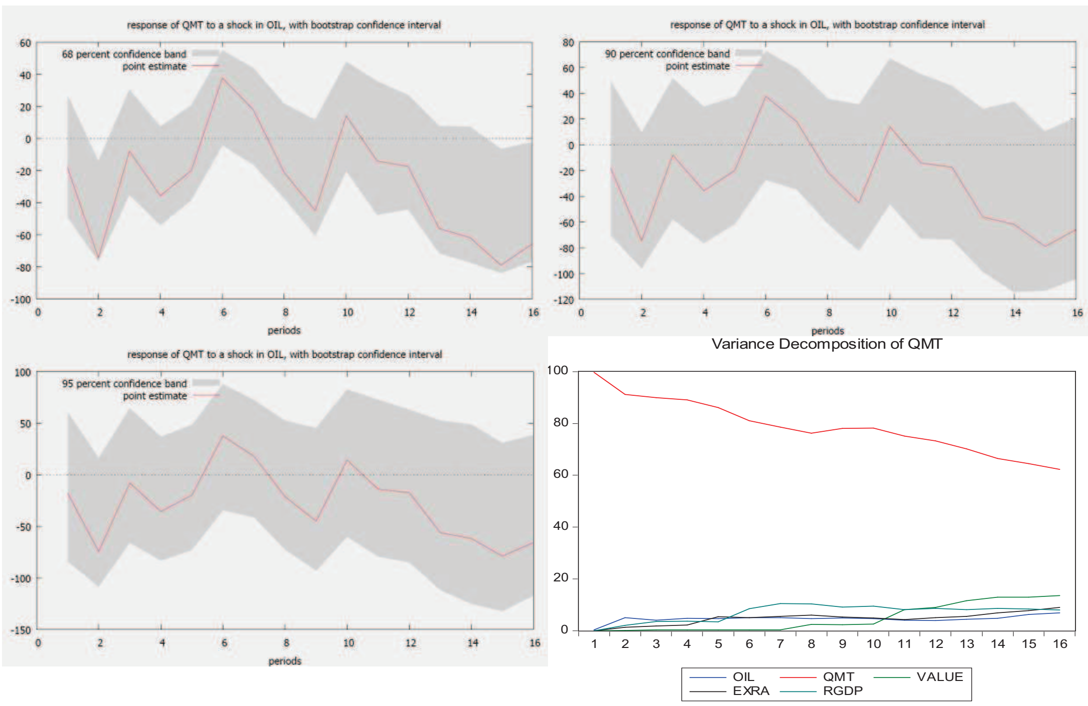
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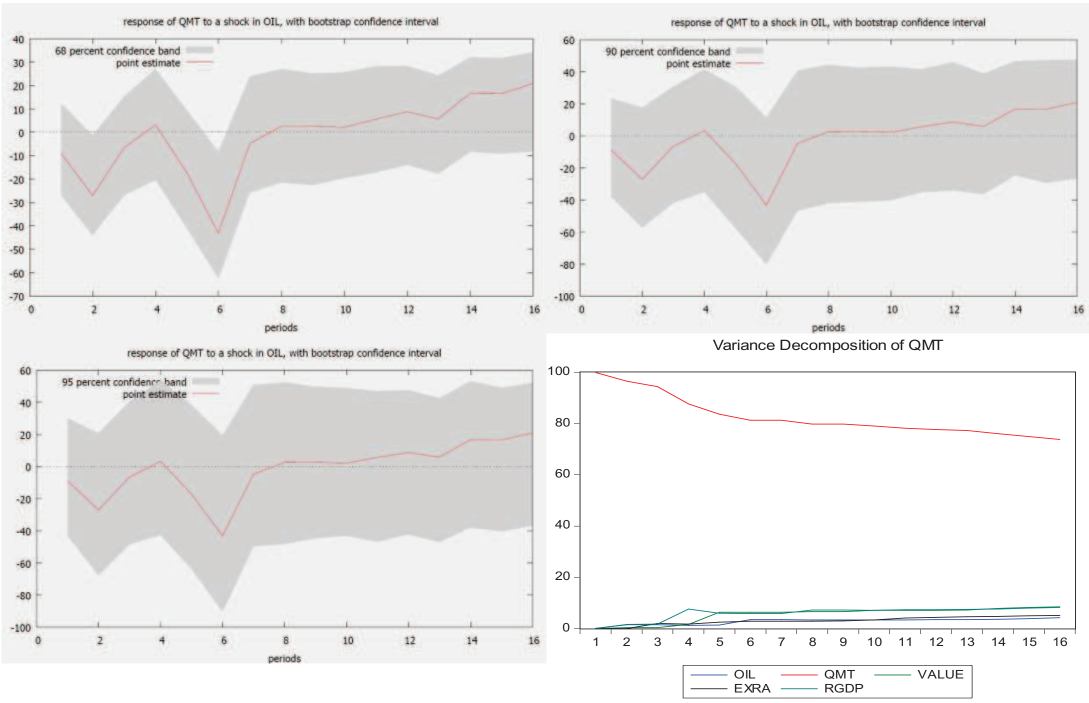
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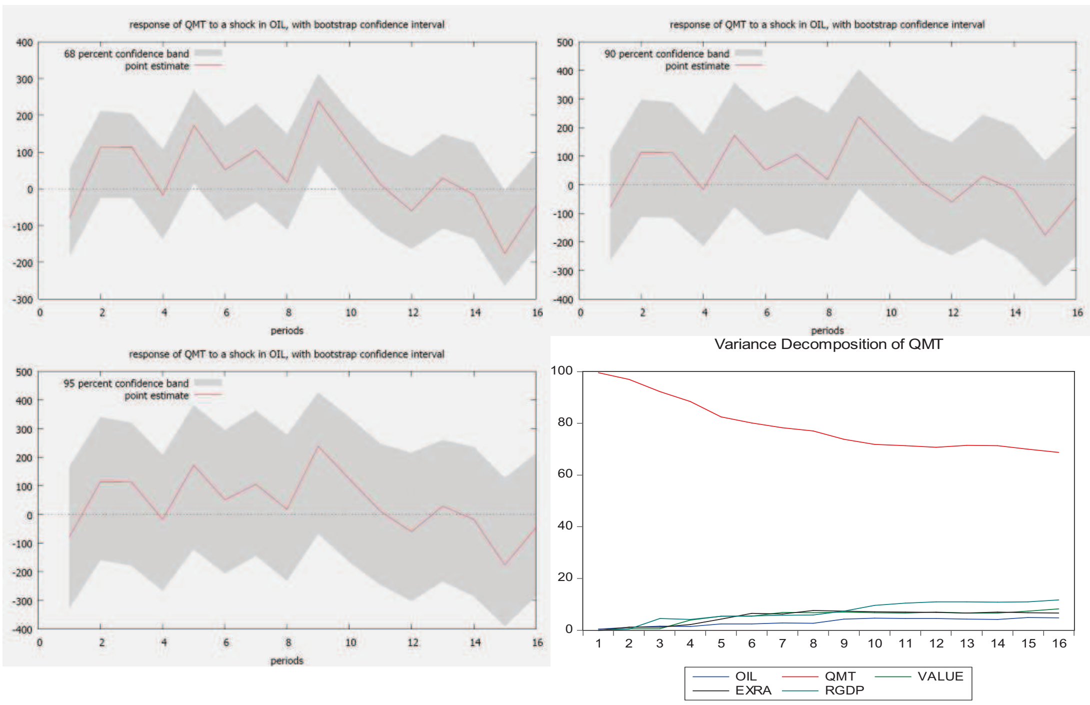
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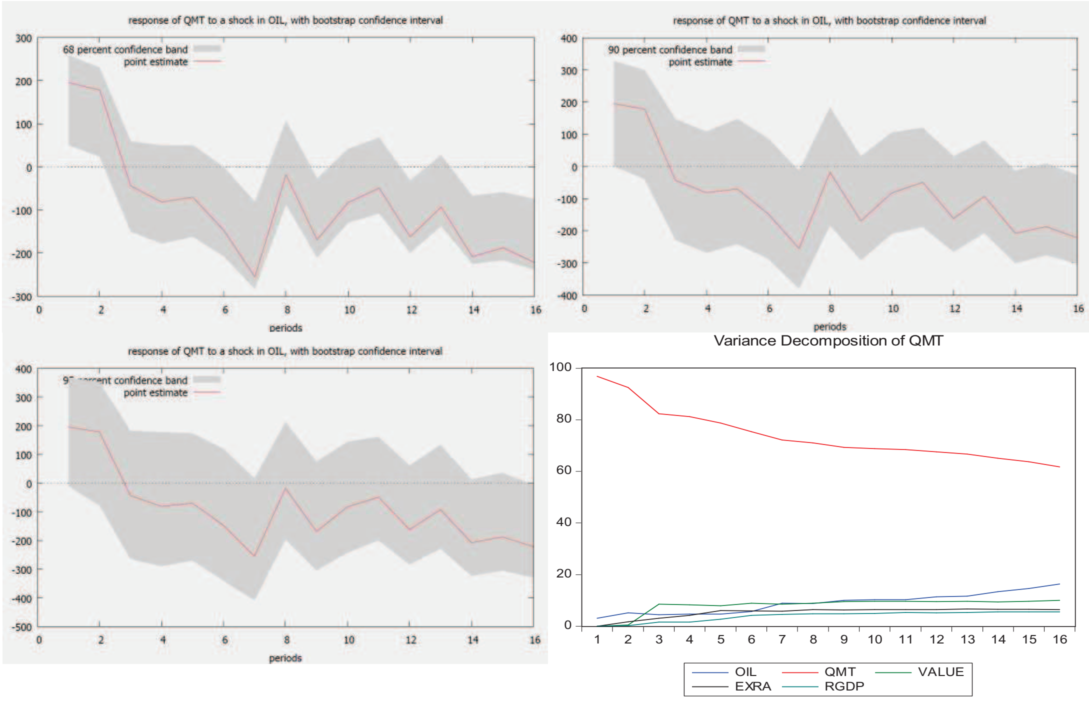
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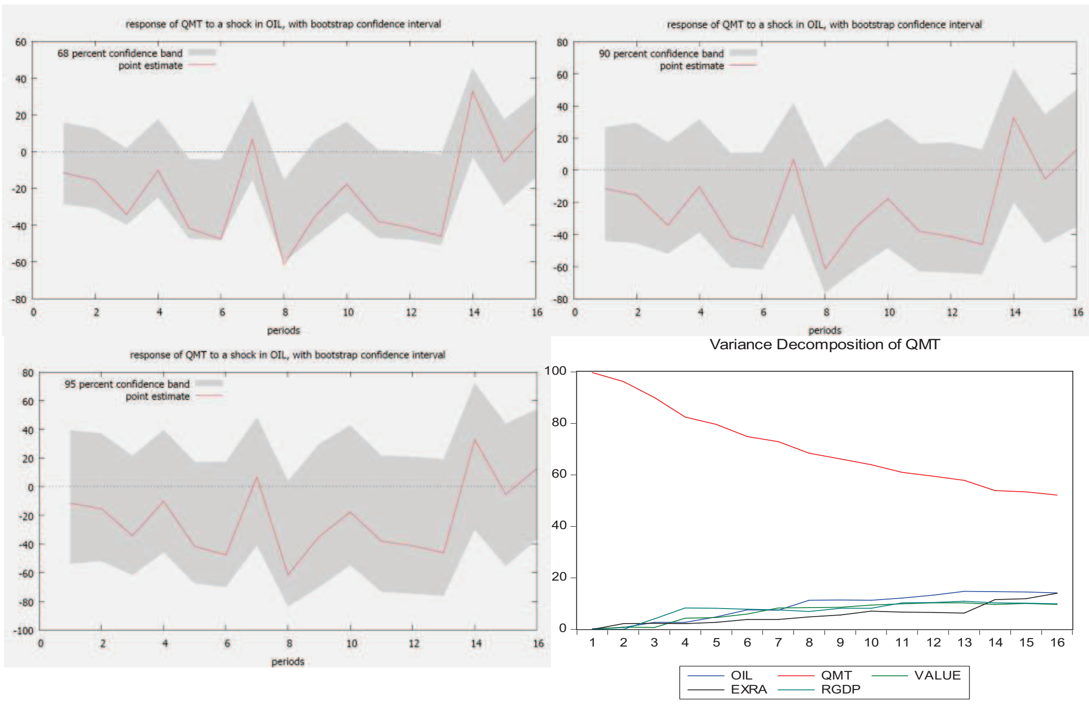
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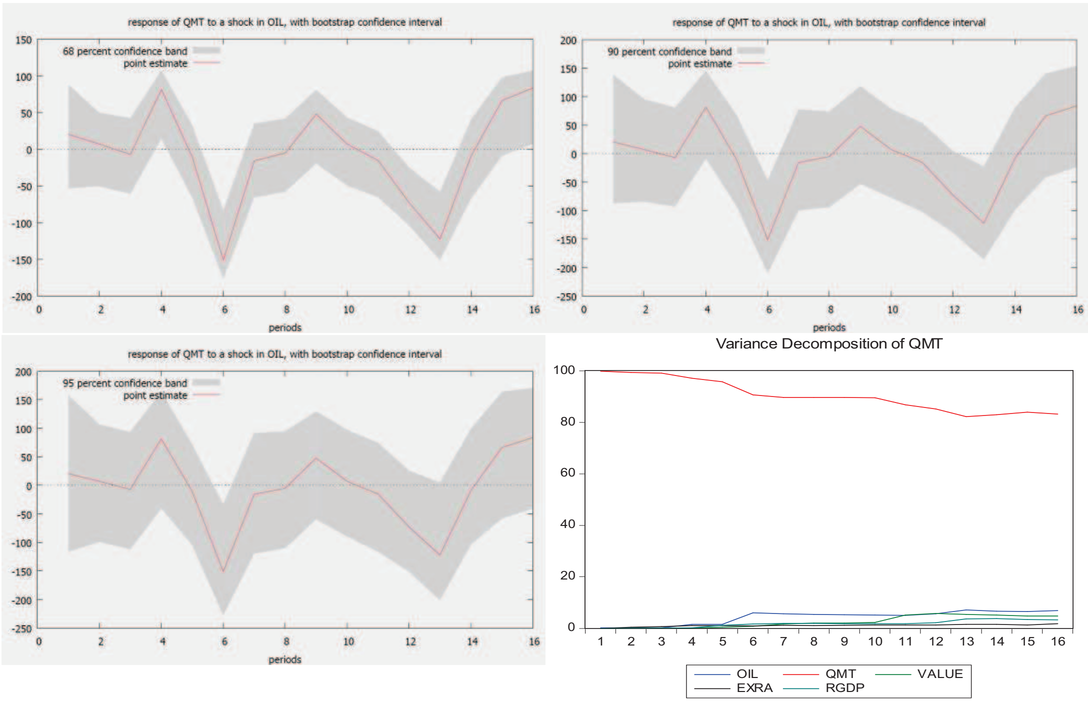
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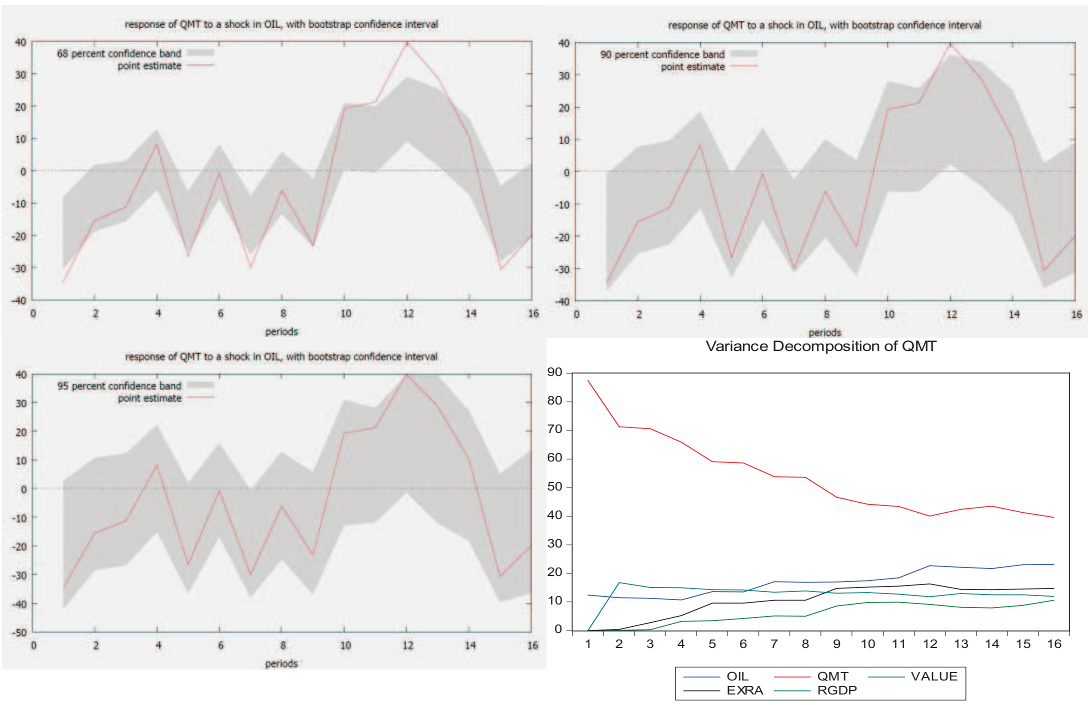
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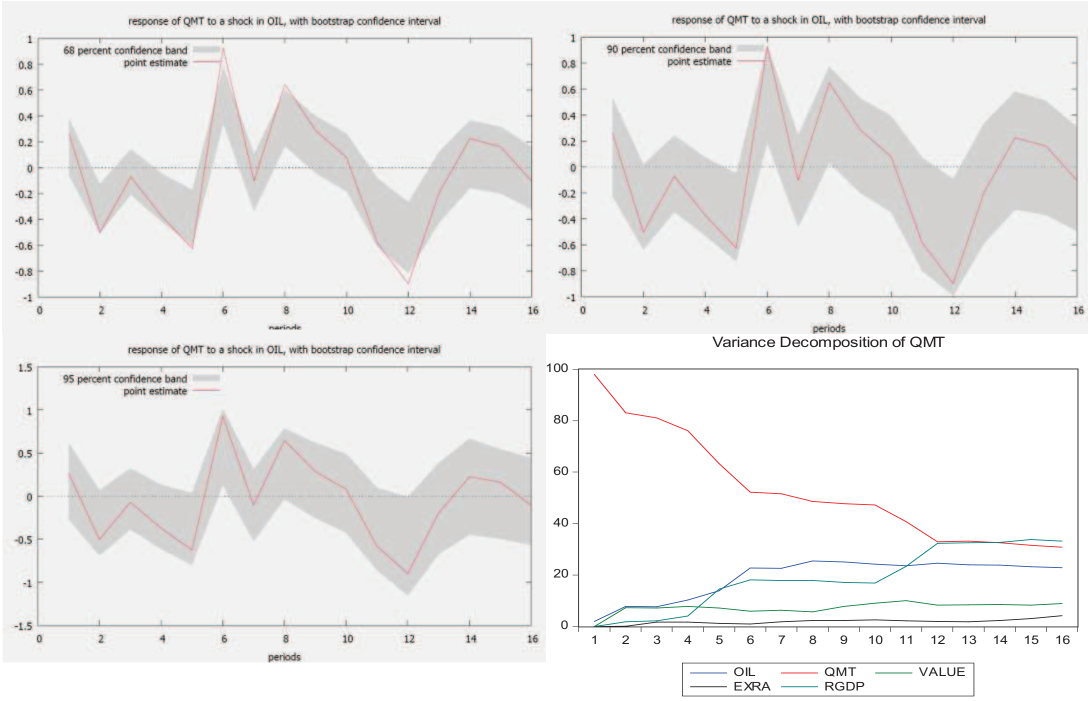
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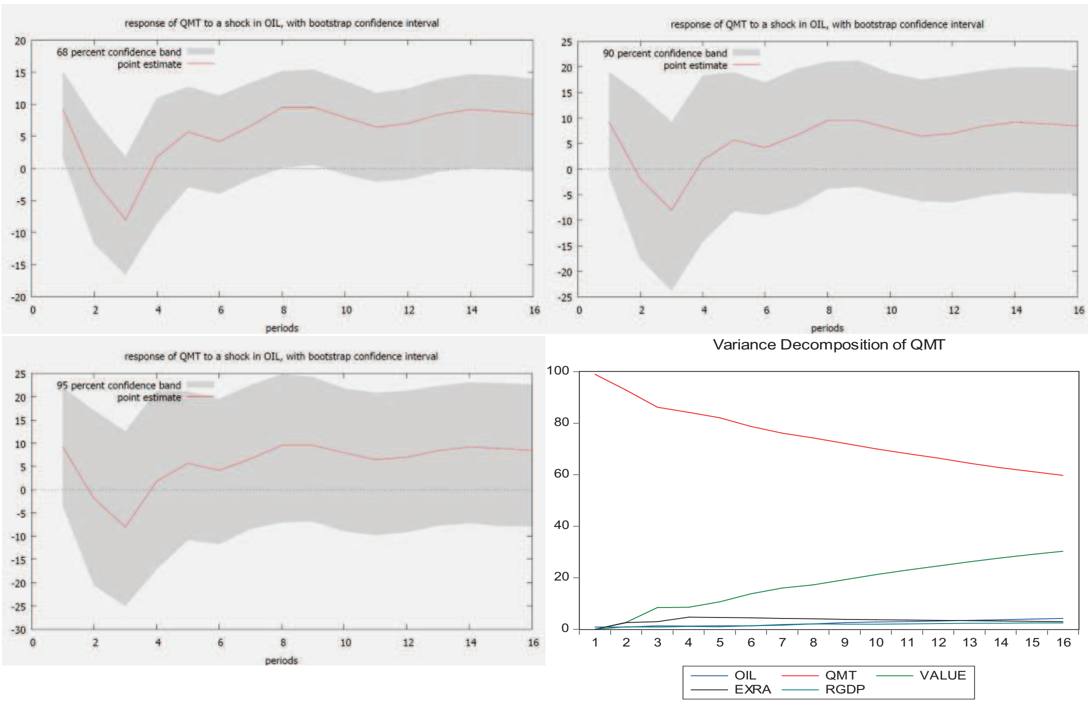
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RGDP

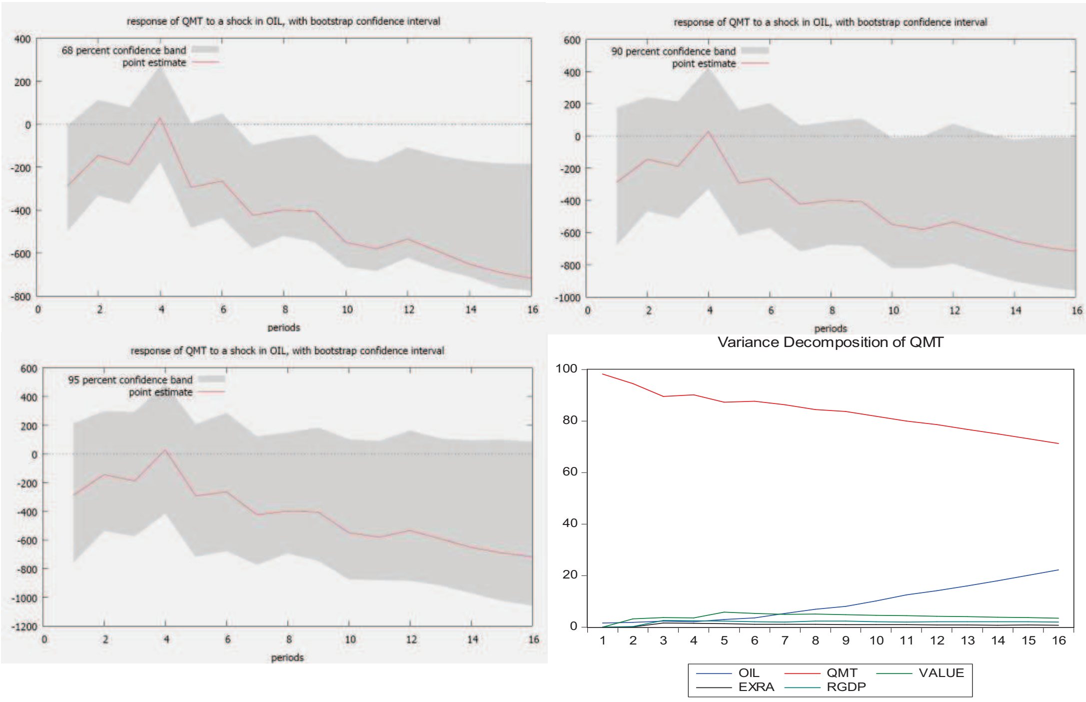
23


response of QMT to a shock in OIL, with bootstrap confidence interval
68 percent confidence band
point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
point estimate
periods
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

28


response of QMT to a shock in OIL, with bootstrap confidence interval
68 percent confidence band
point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
90 percent confidence band
point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
95 percent confidence band
point estimate
periods
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

29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68 percent confidence band
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90 percent confidence band
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periods
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Variance Decomposition of QMT
OIL
QMT
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RGDP

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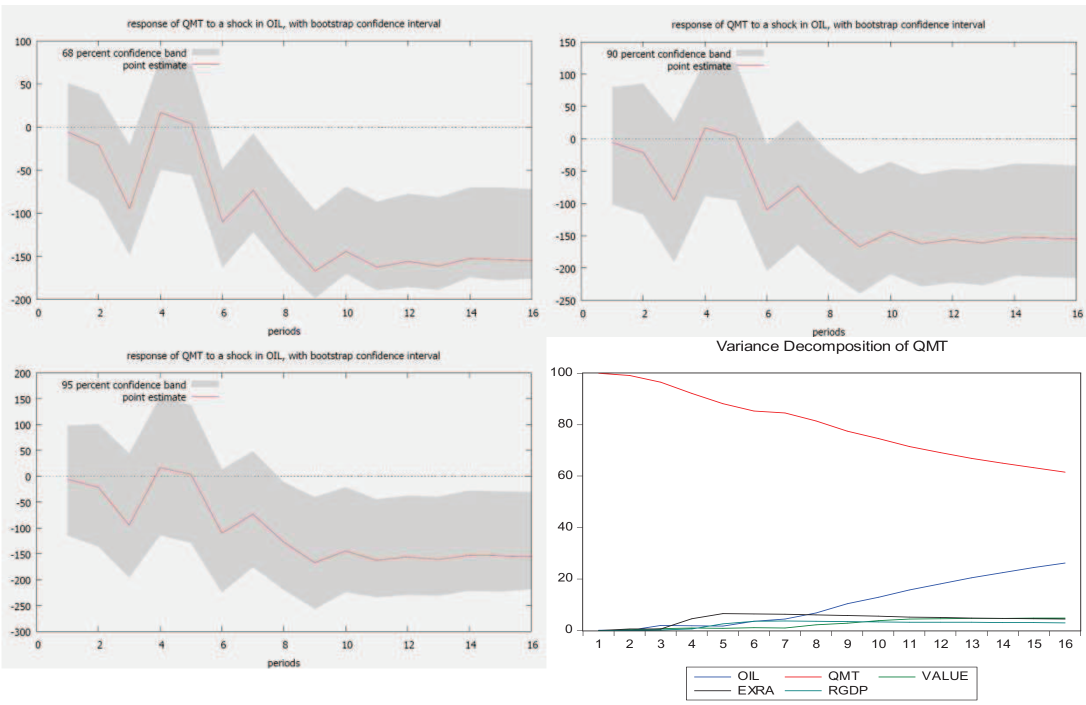
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periods
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95 percent confidence band
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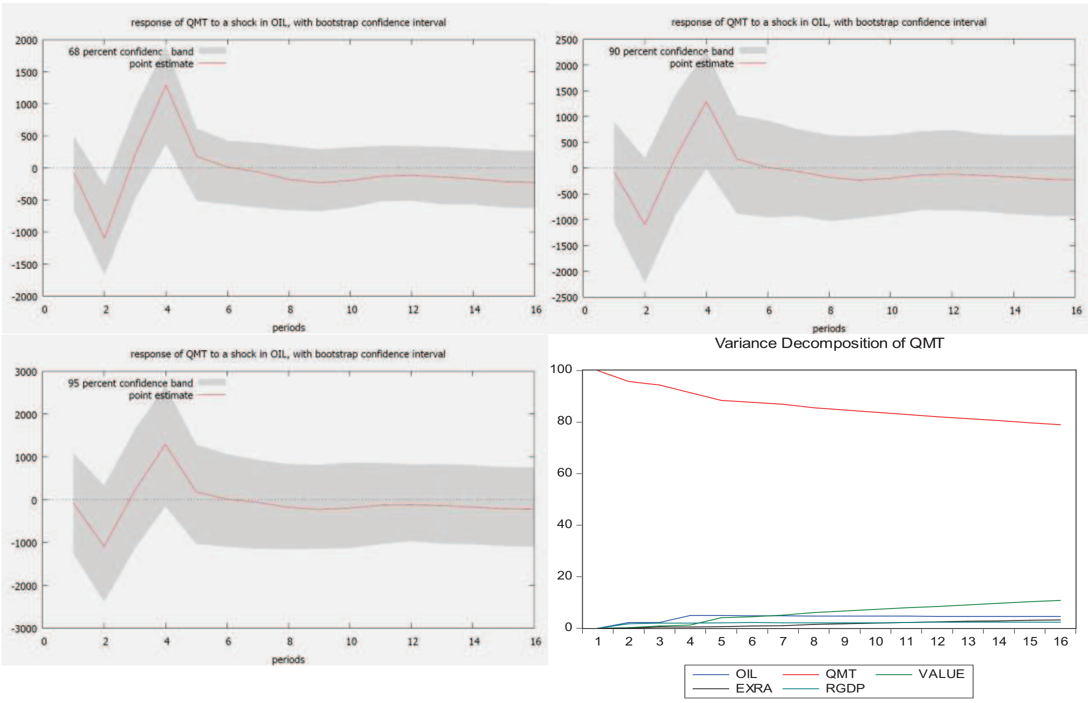
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

31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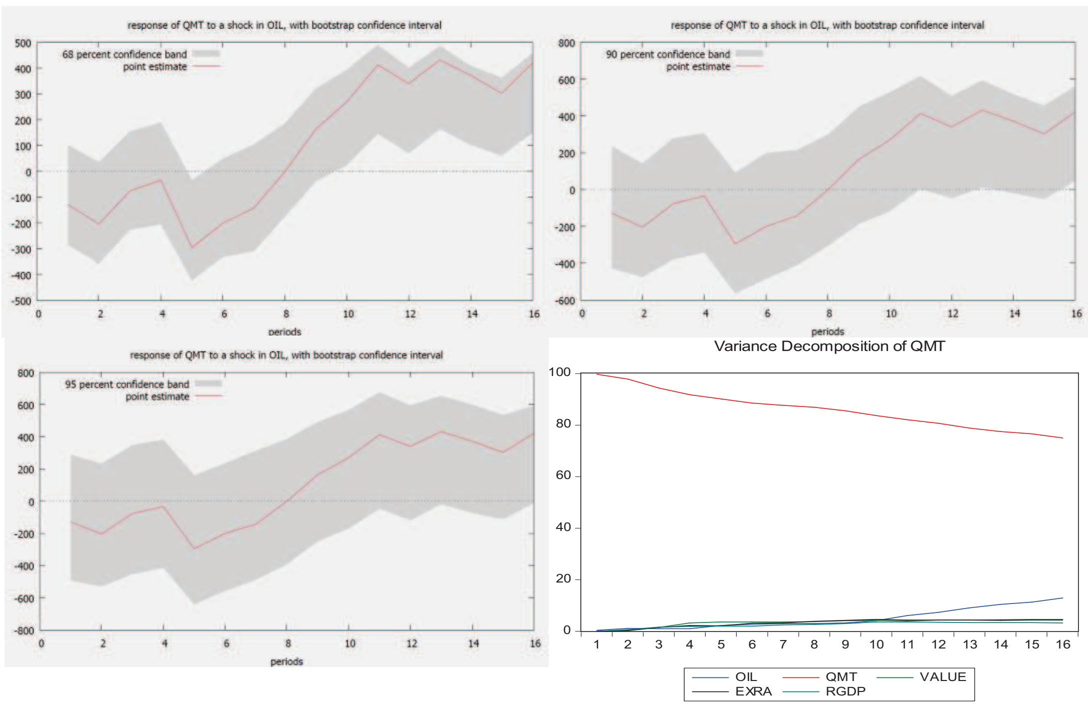
periods
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

32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OIL
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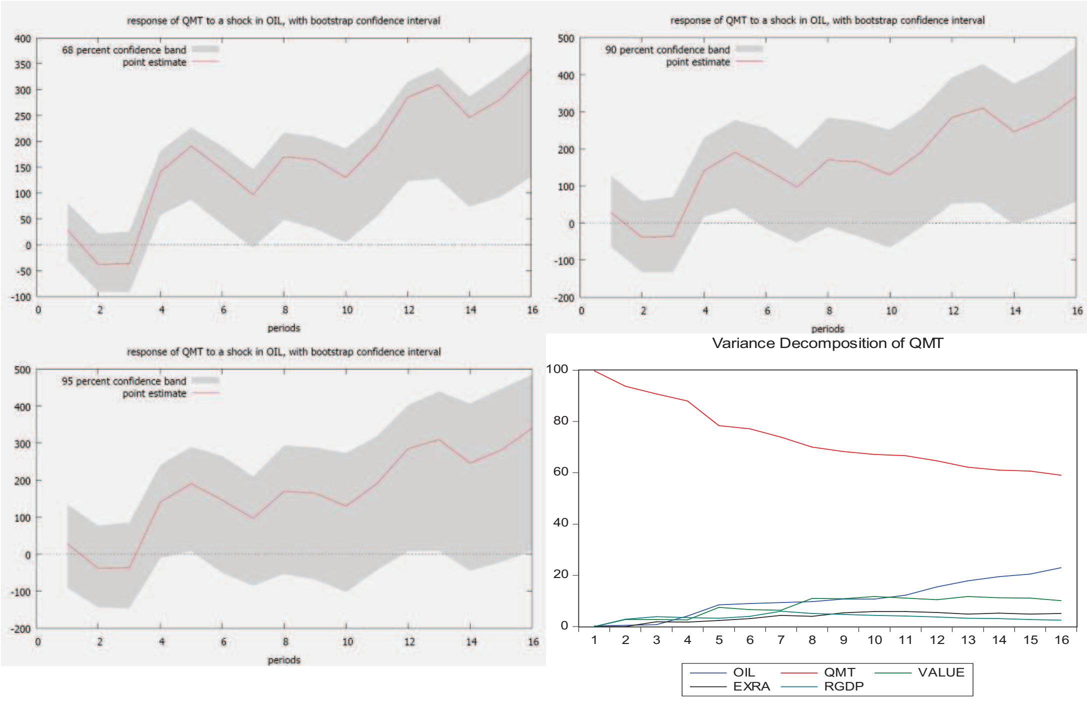
33A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Variance Decomposition of QMT
OIL
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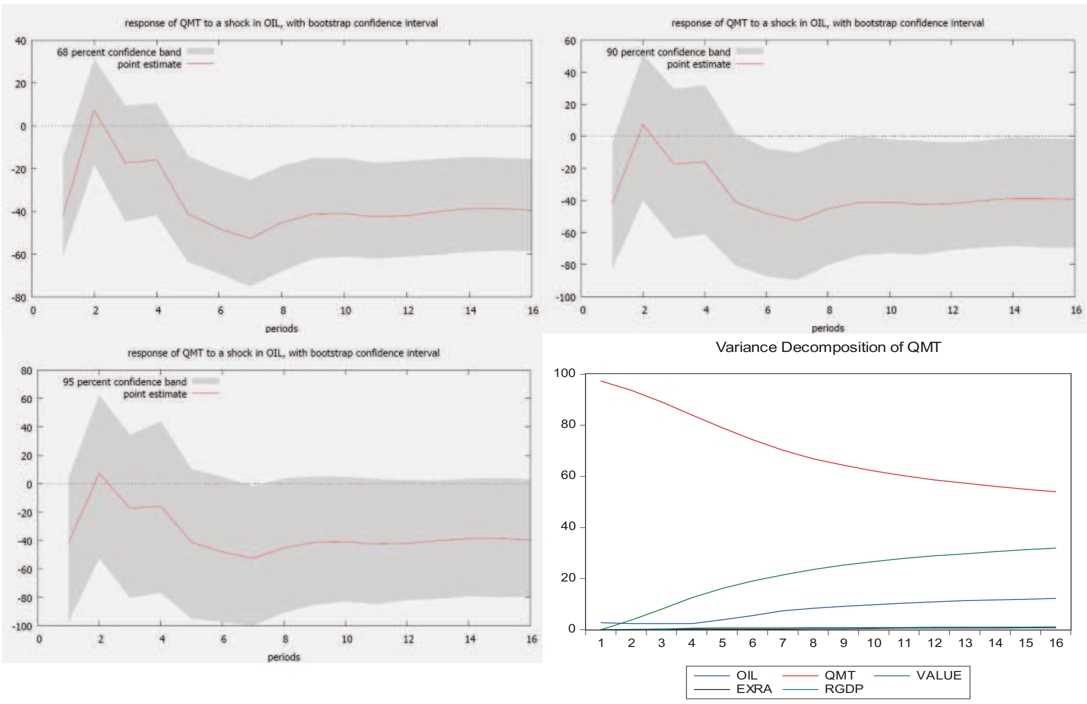
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OIL
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RGDP

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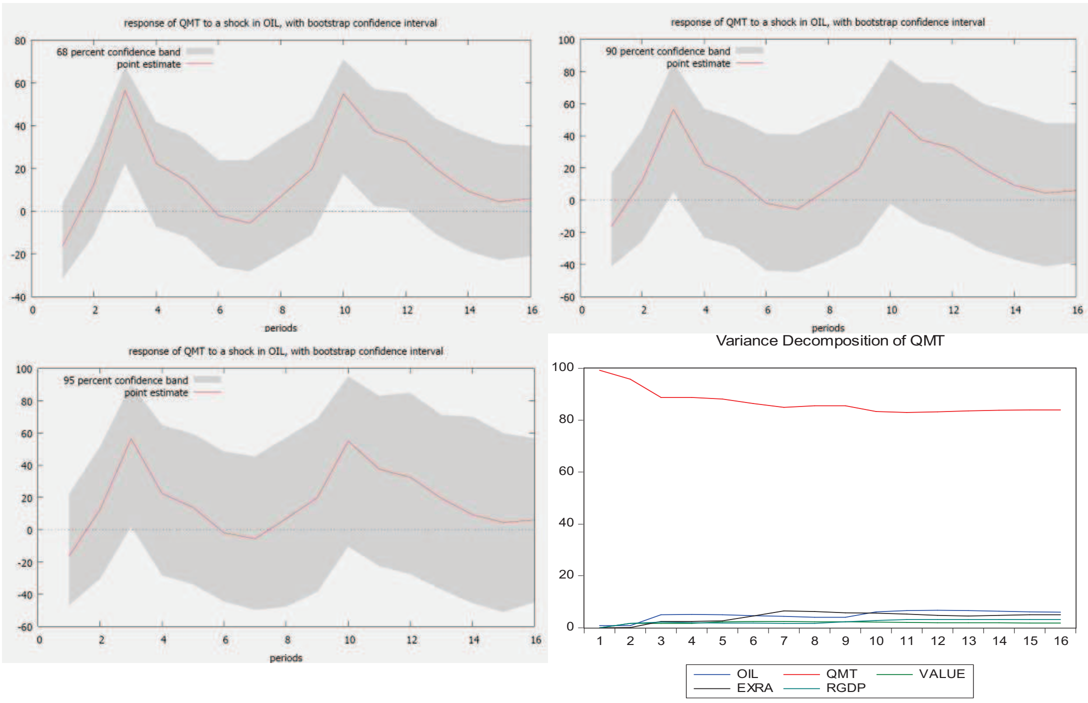
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90 percent confidence band
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OIL
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RGDP

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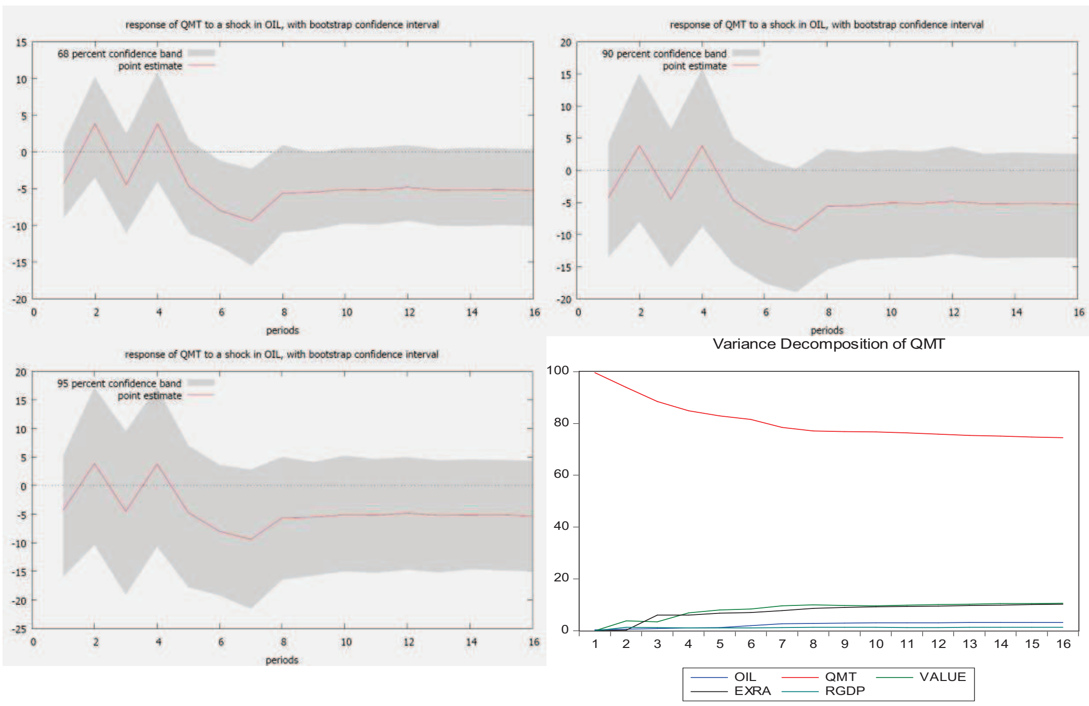
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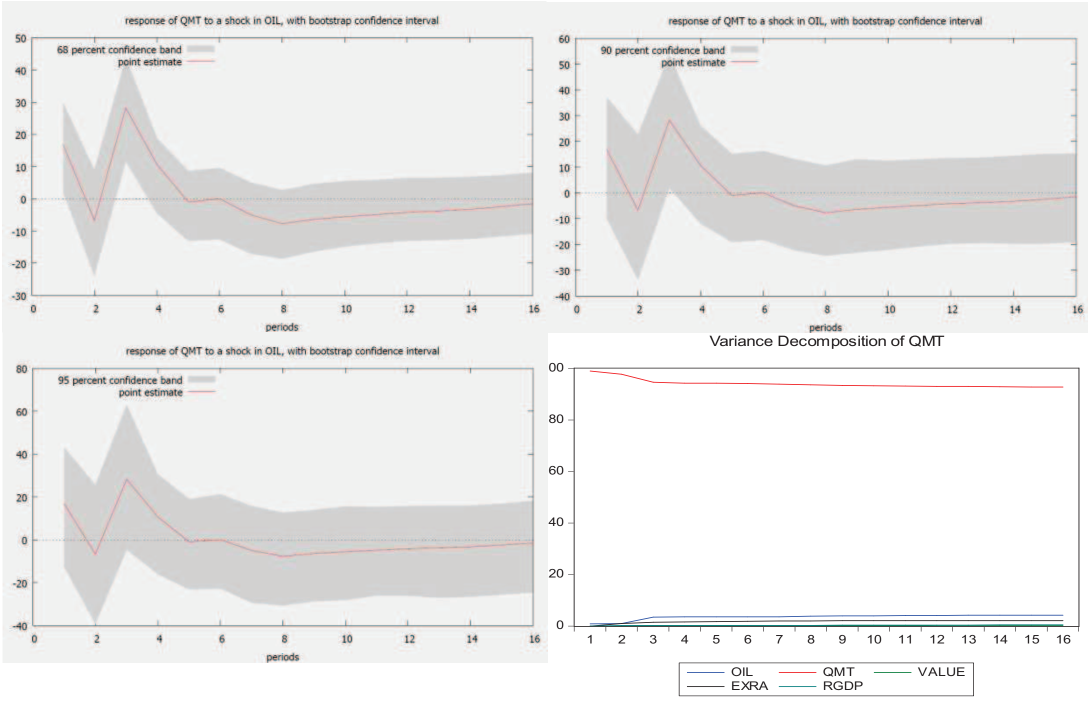

4.2.1.3 Germany

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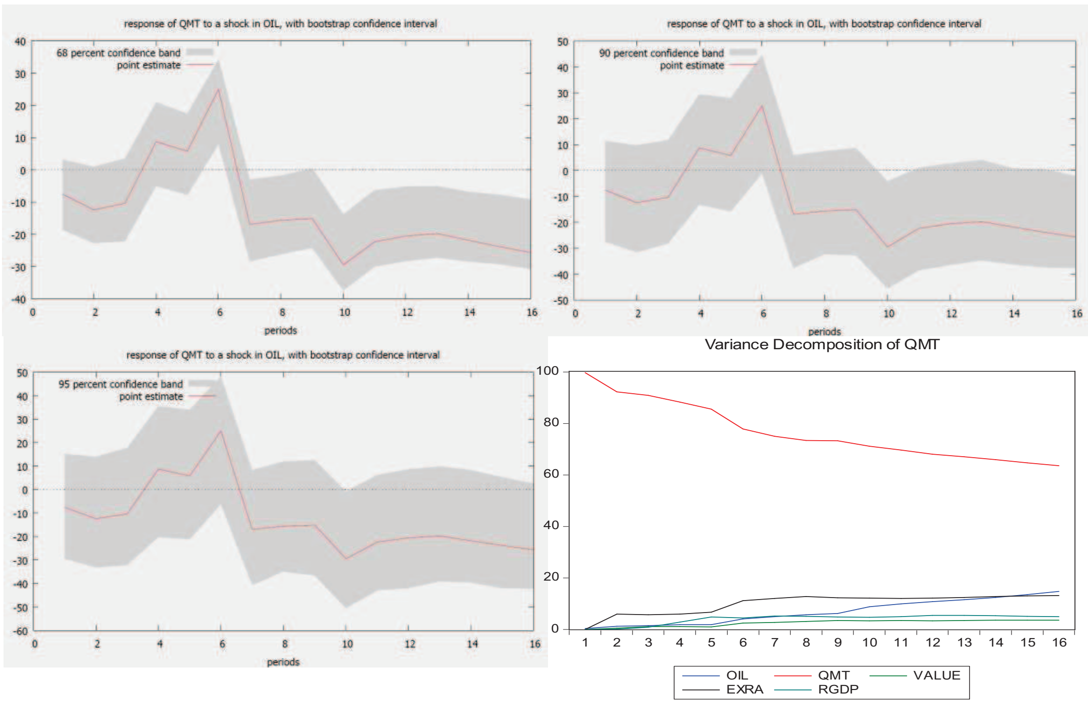

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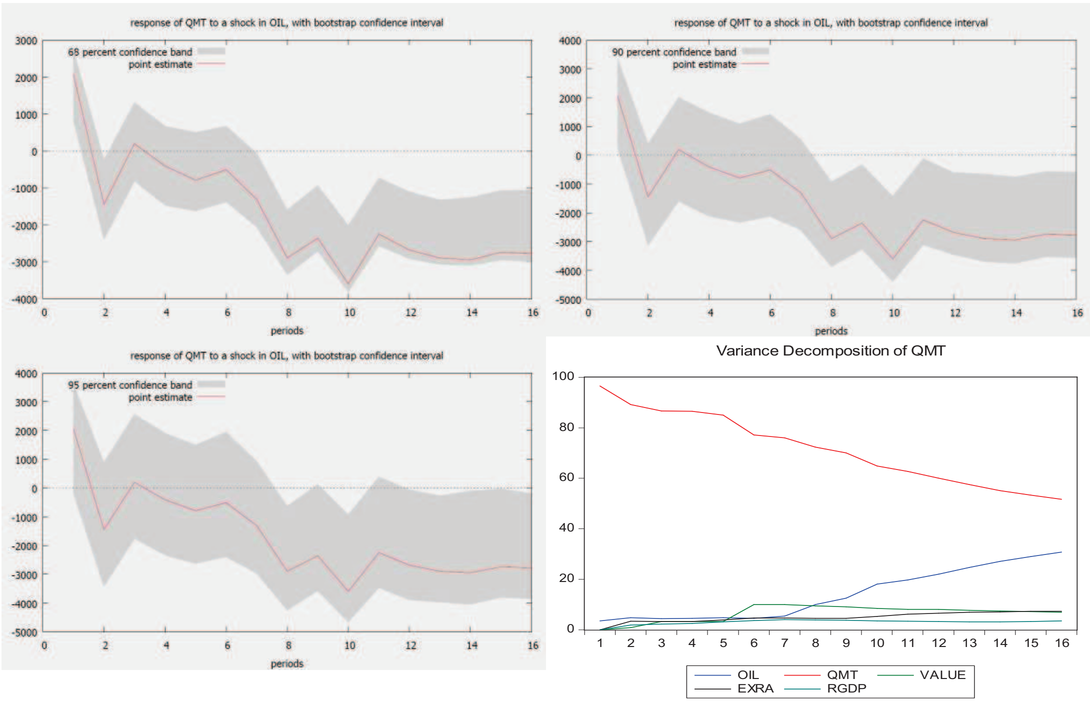
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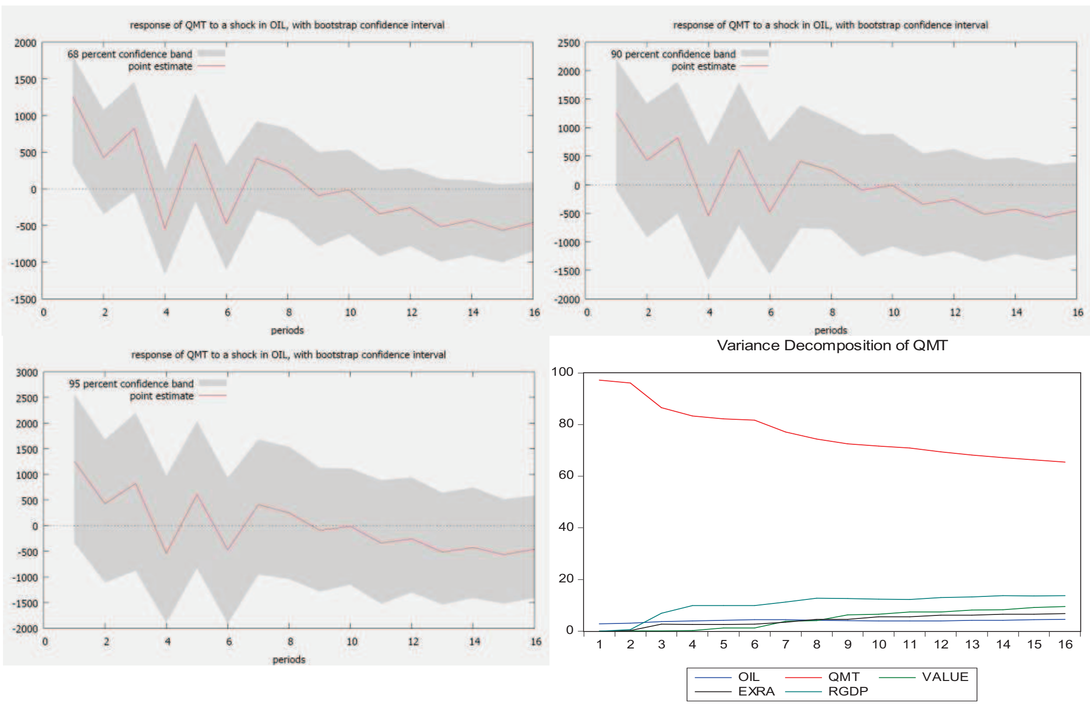
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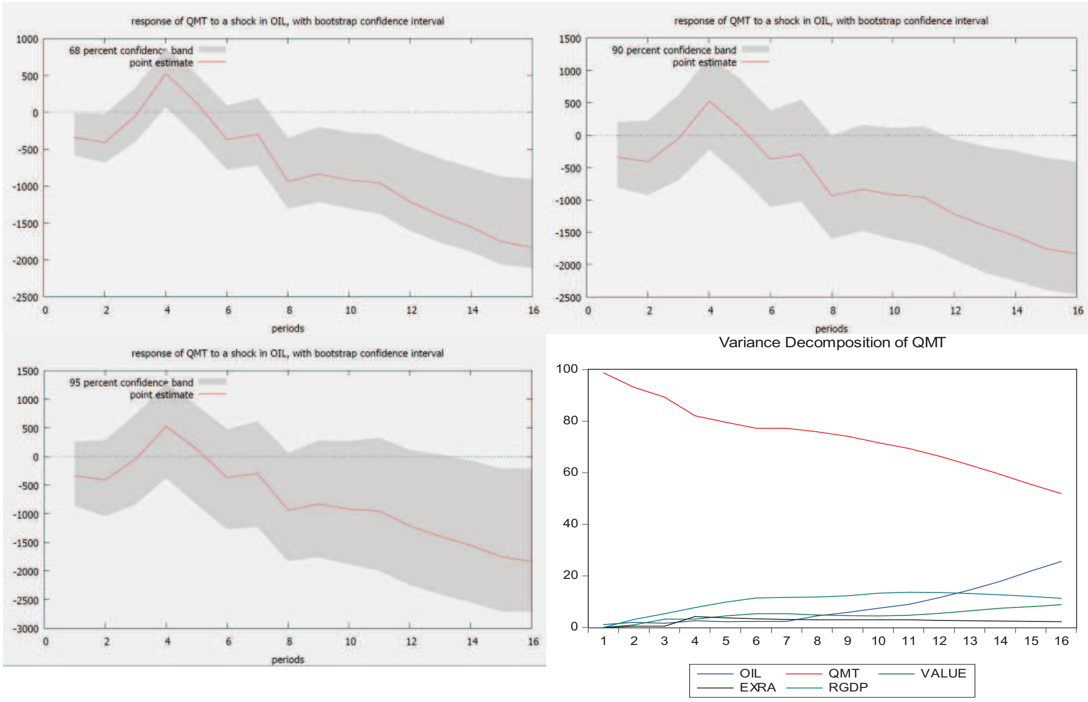
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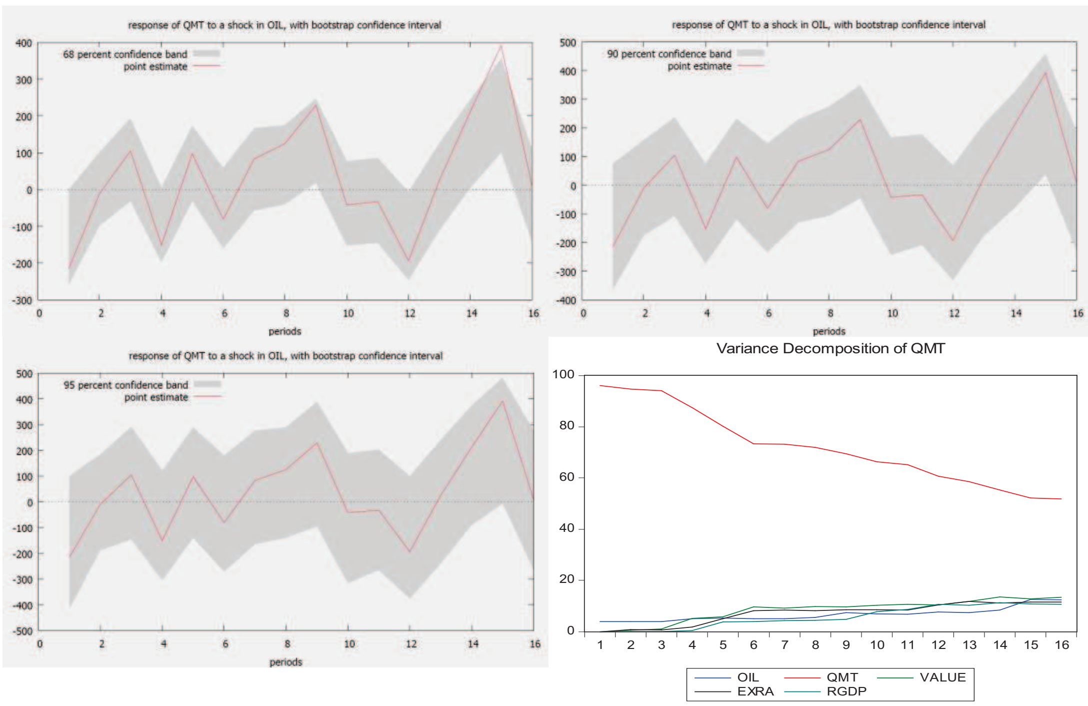
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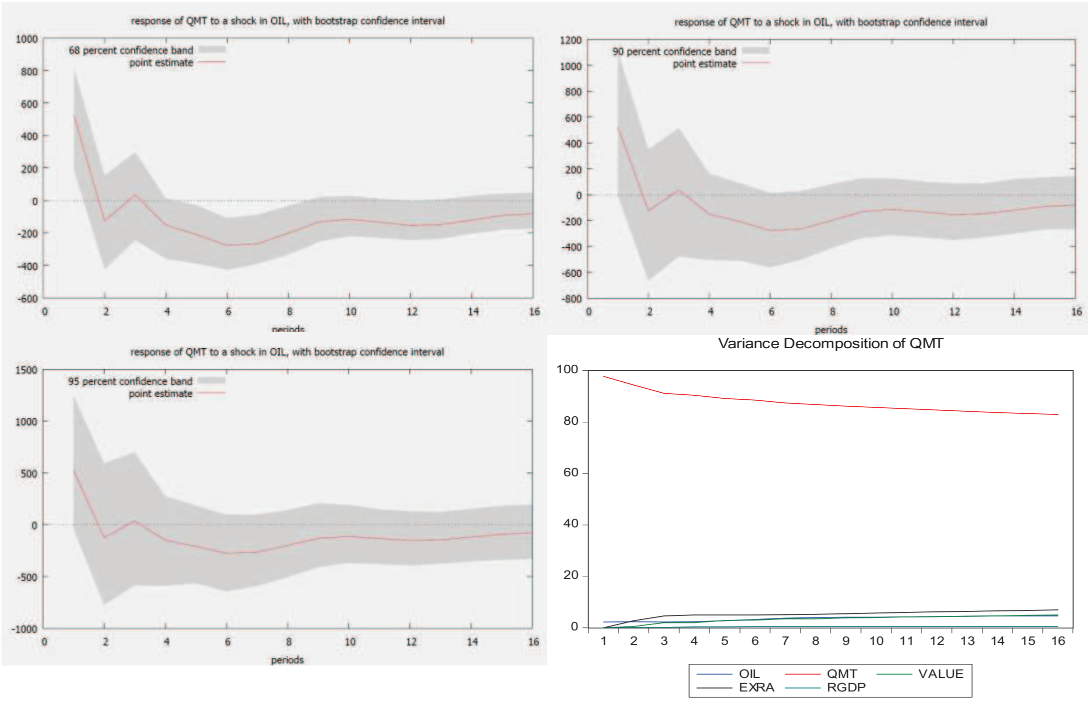
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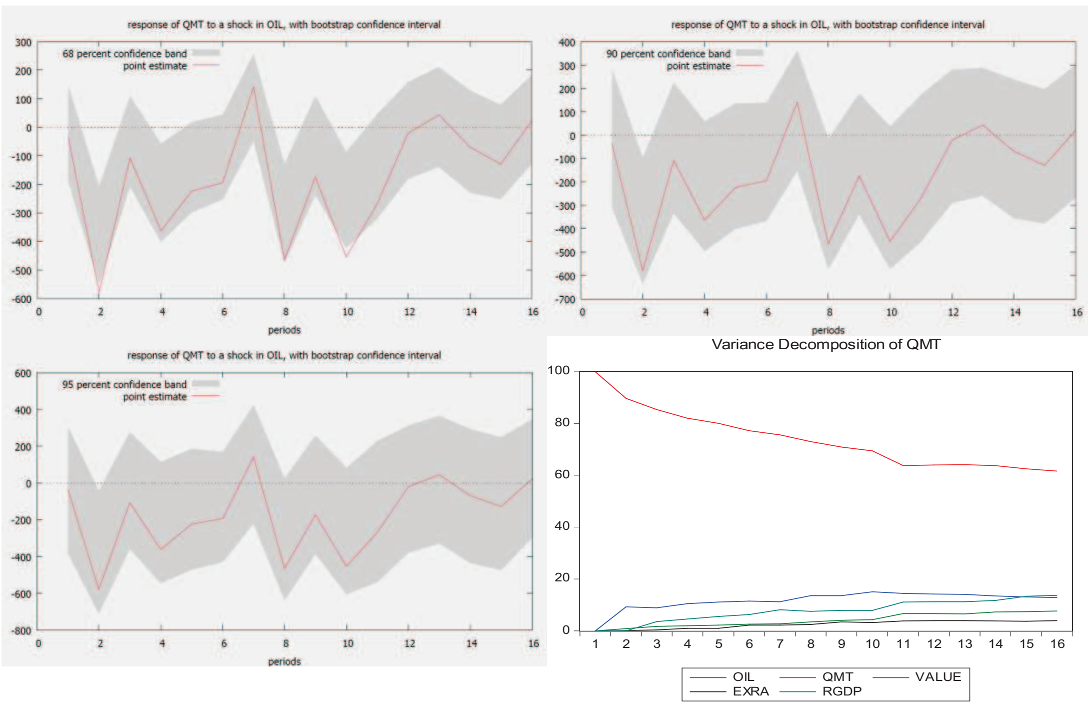
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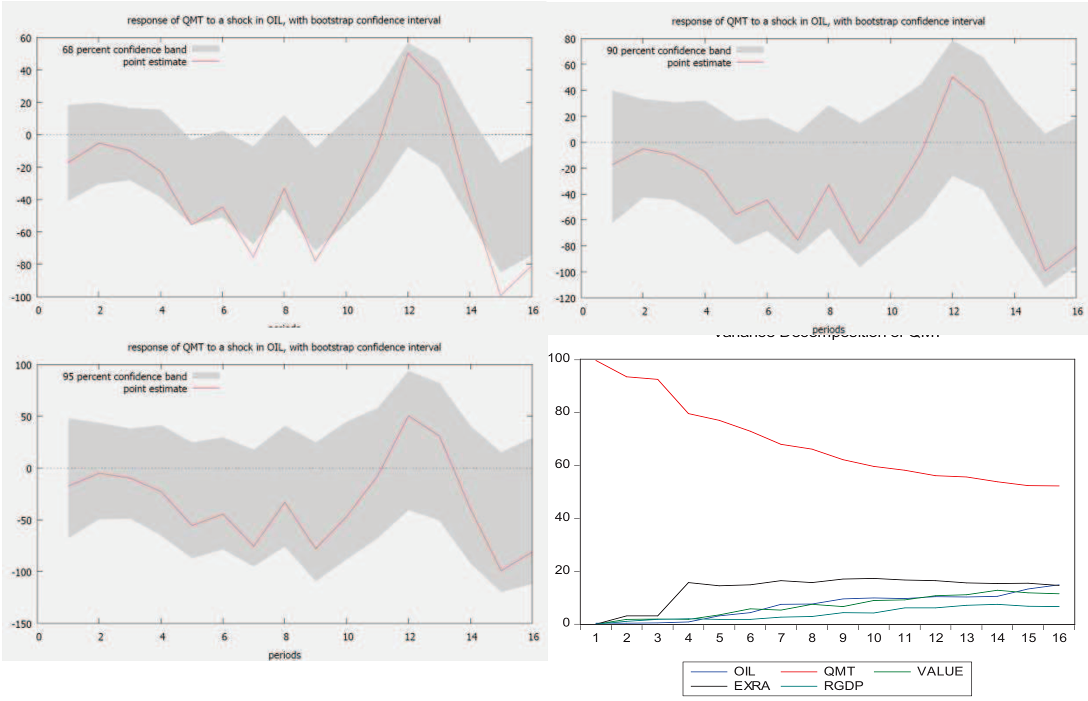
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95 percent confidence band
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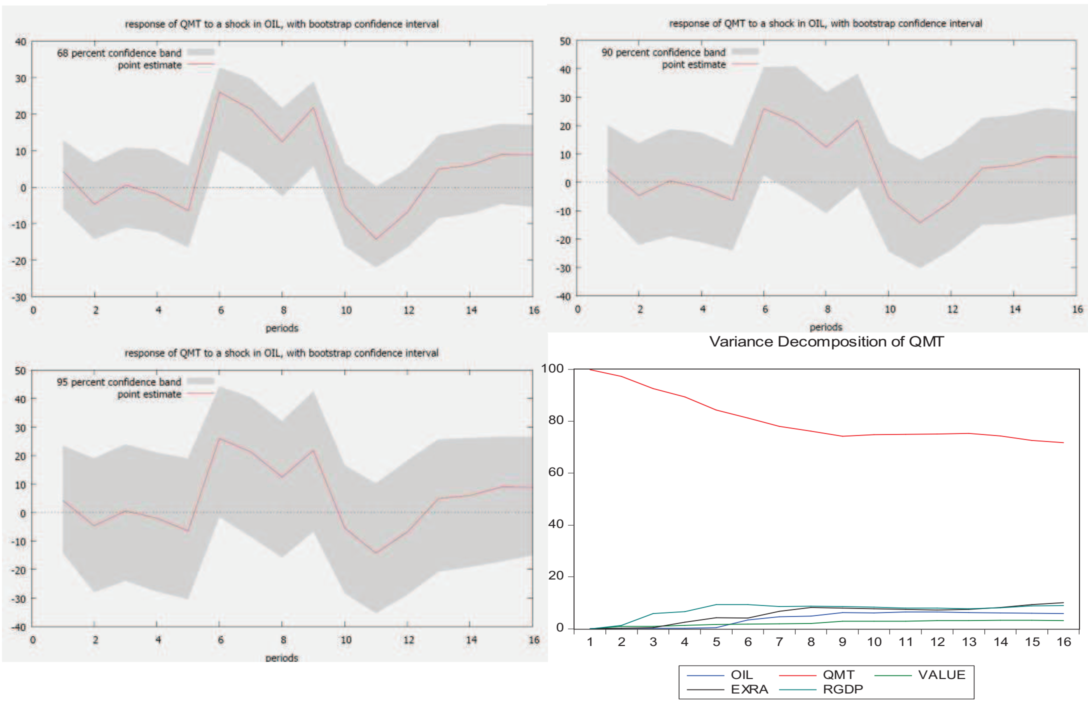
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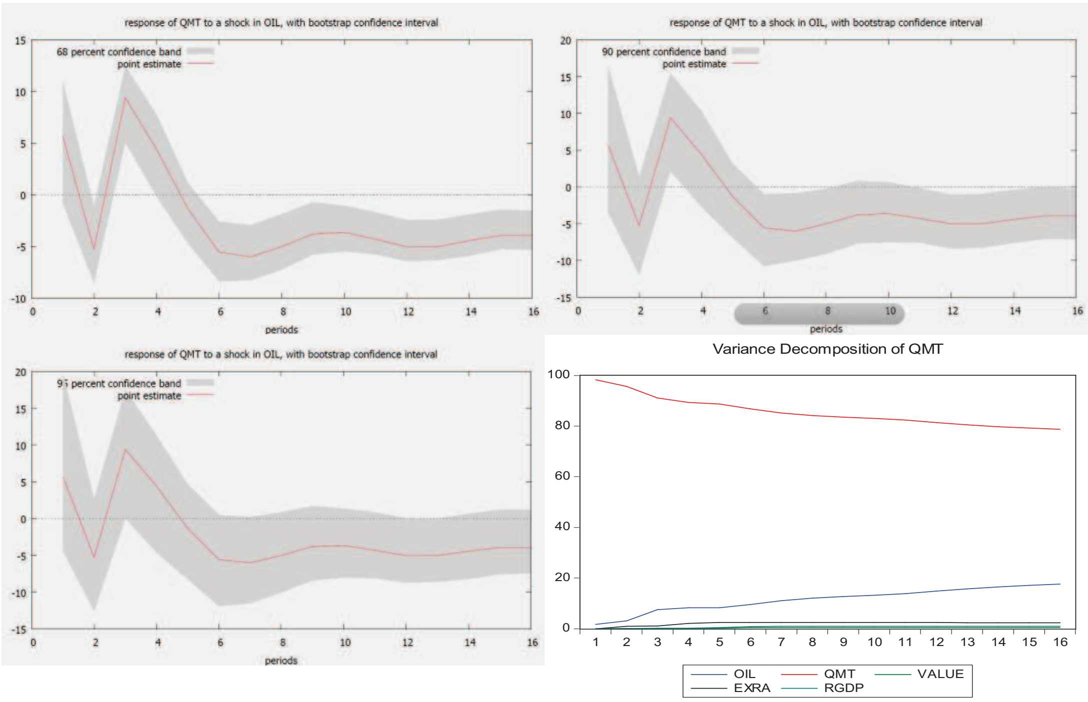
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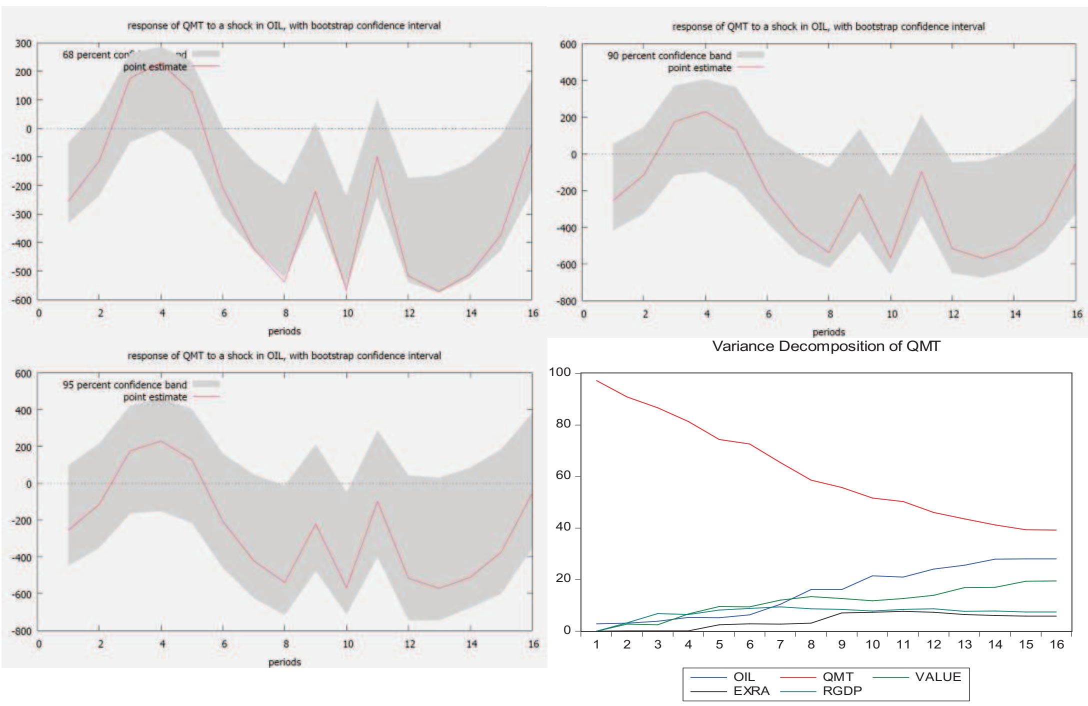
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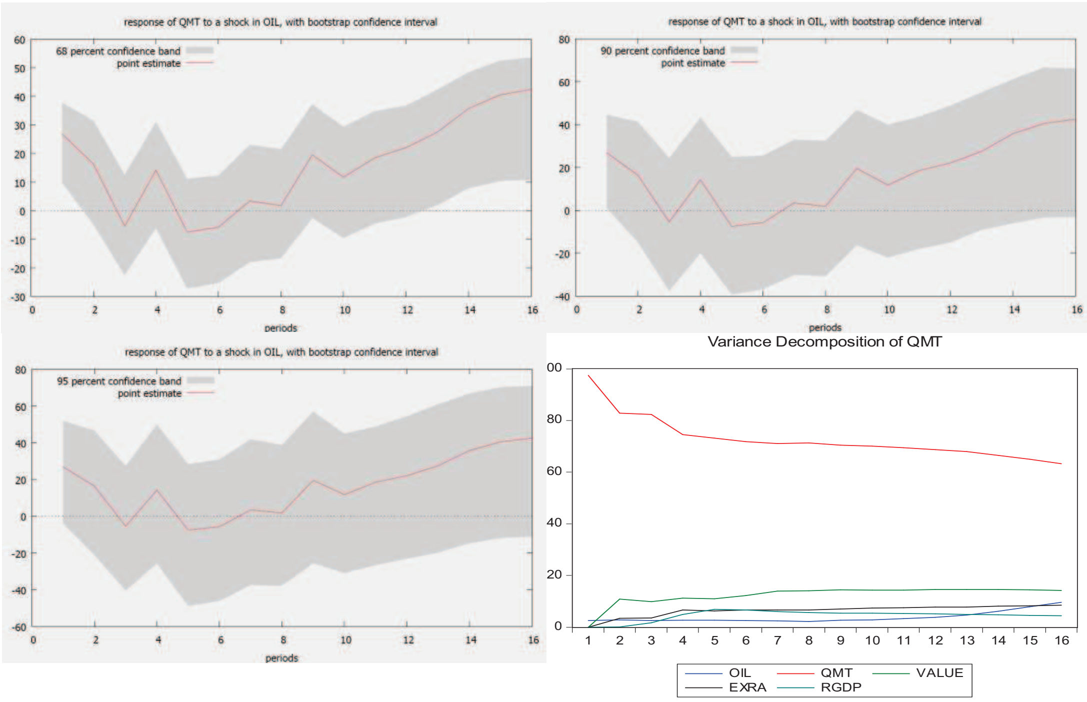
14A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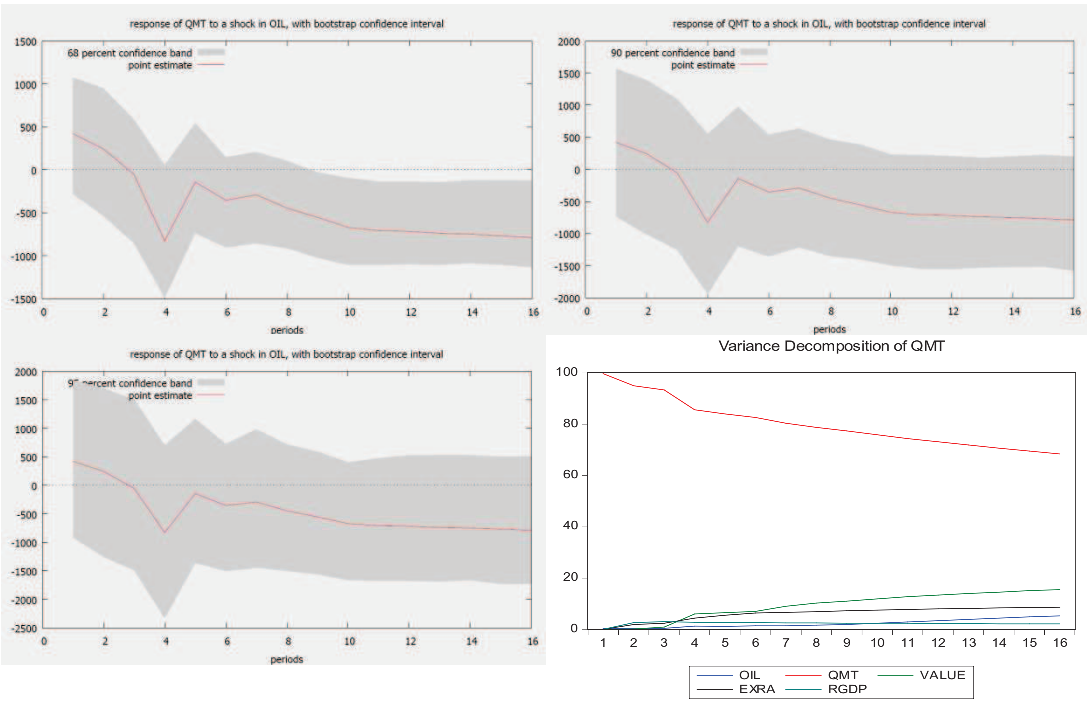
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Variance Decomposition of QMT
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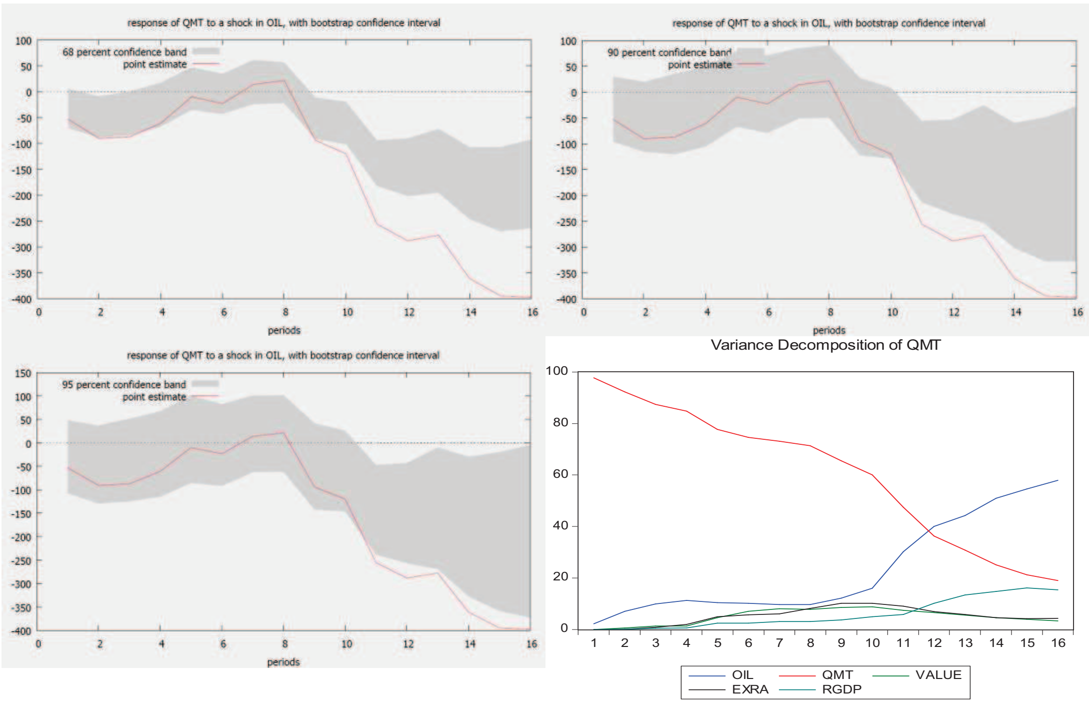
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Variance Decomposition of QMT
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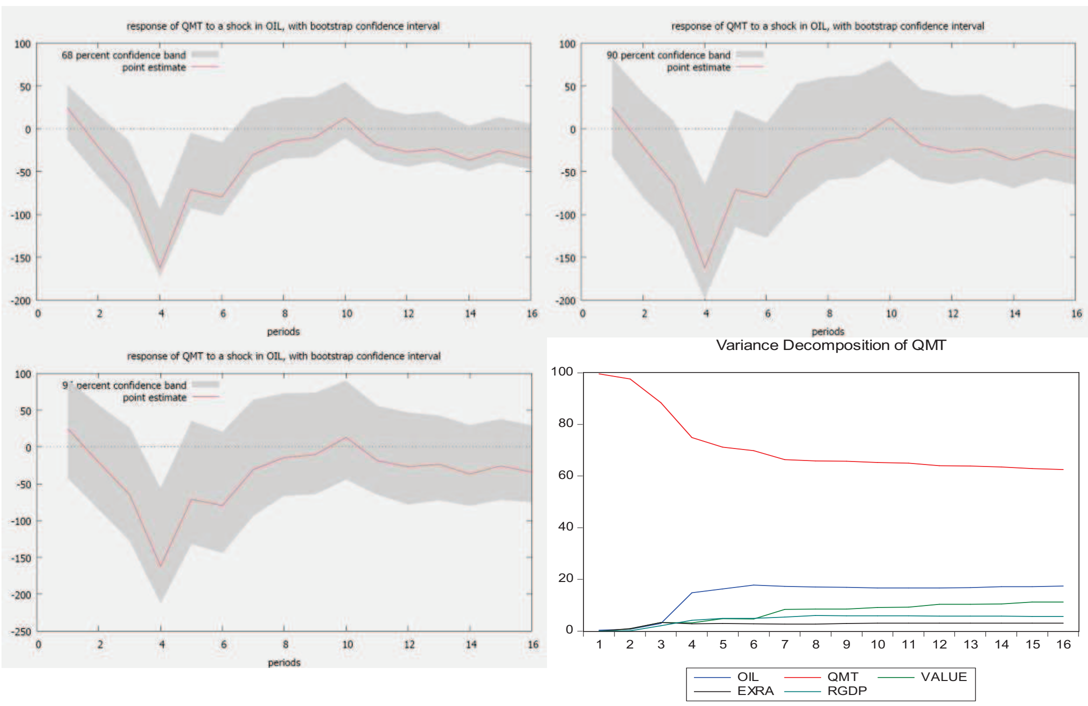
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Variance Decomposition of QMT
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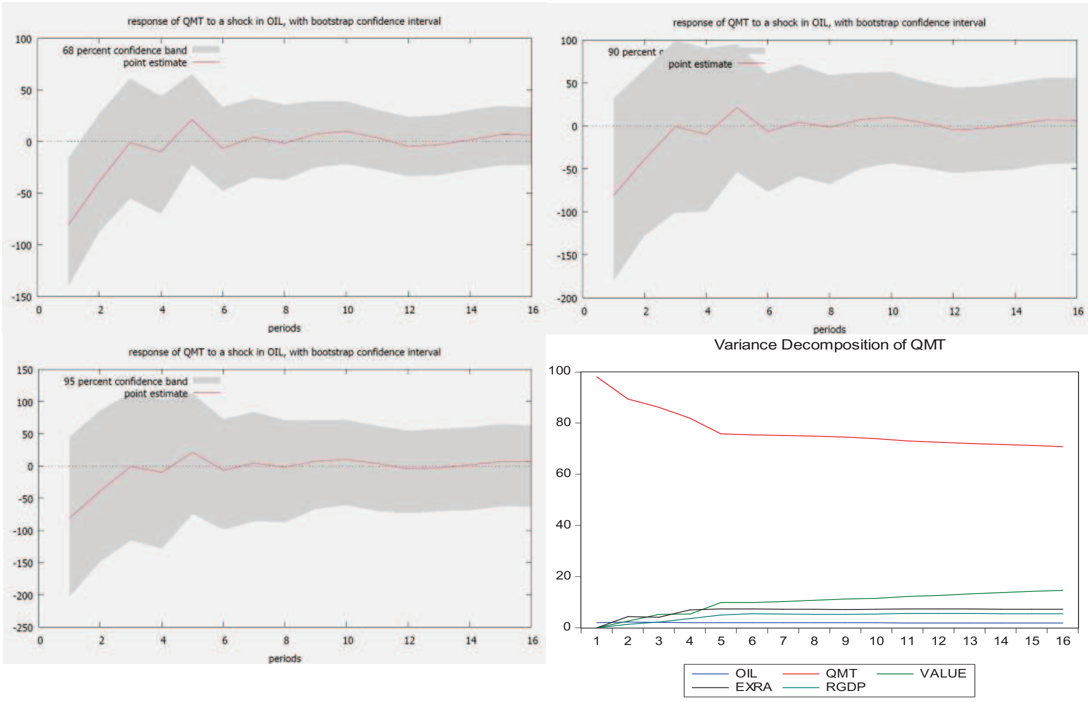
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Variance Decomposition of QMT
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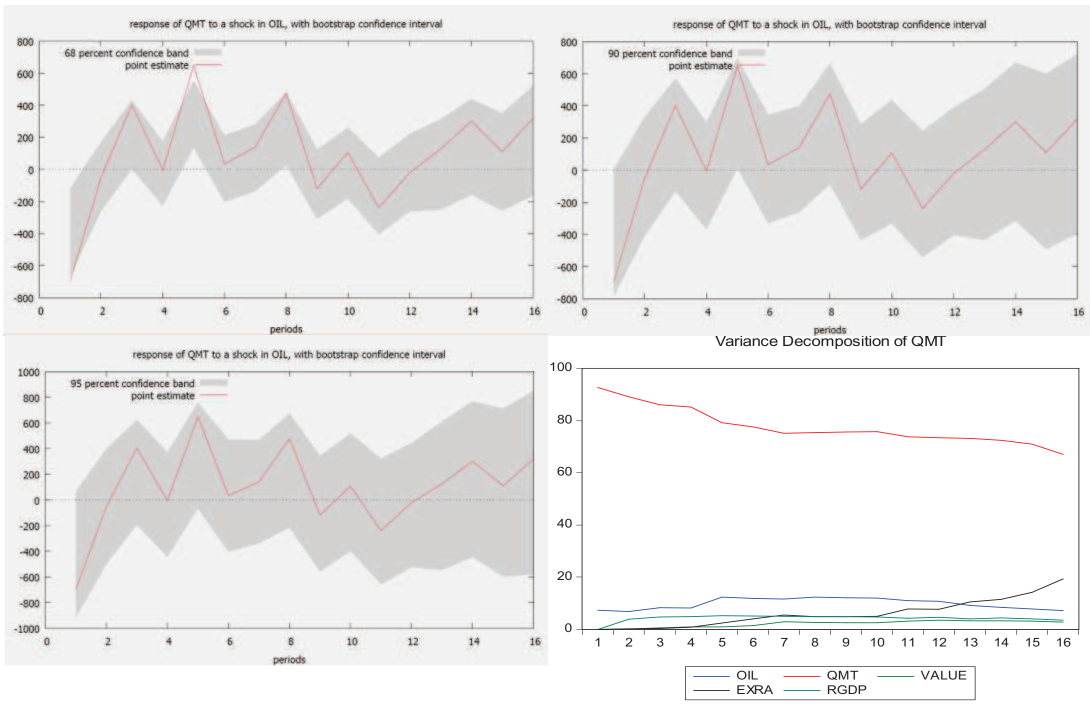
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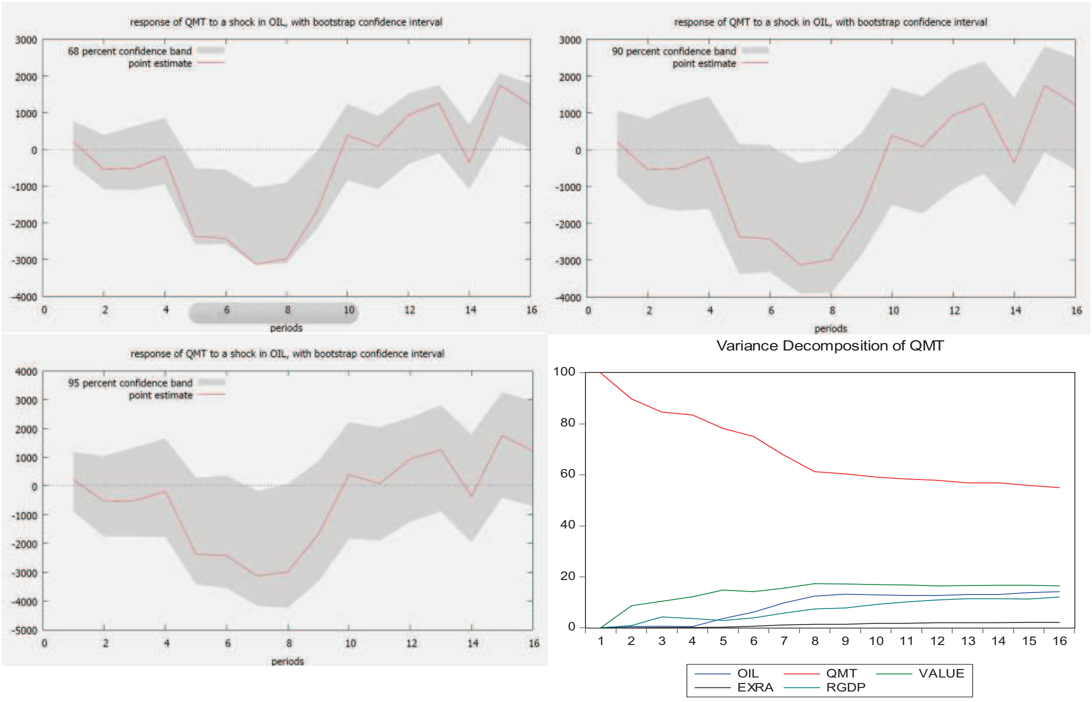
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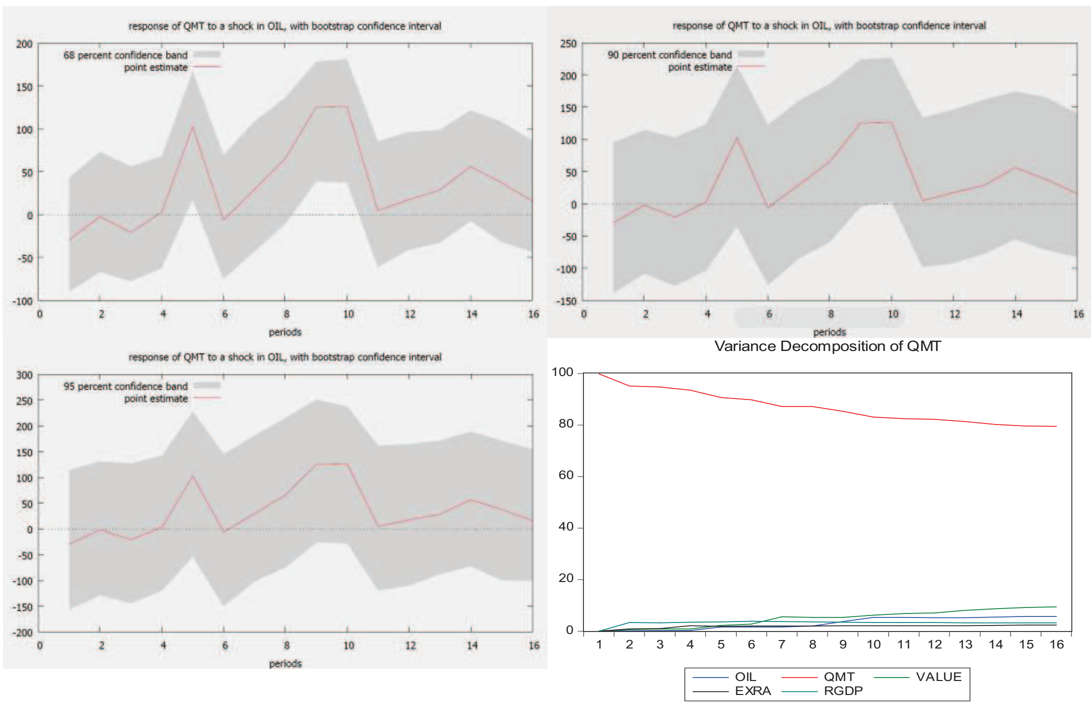
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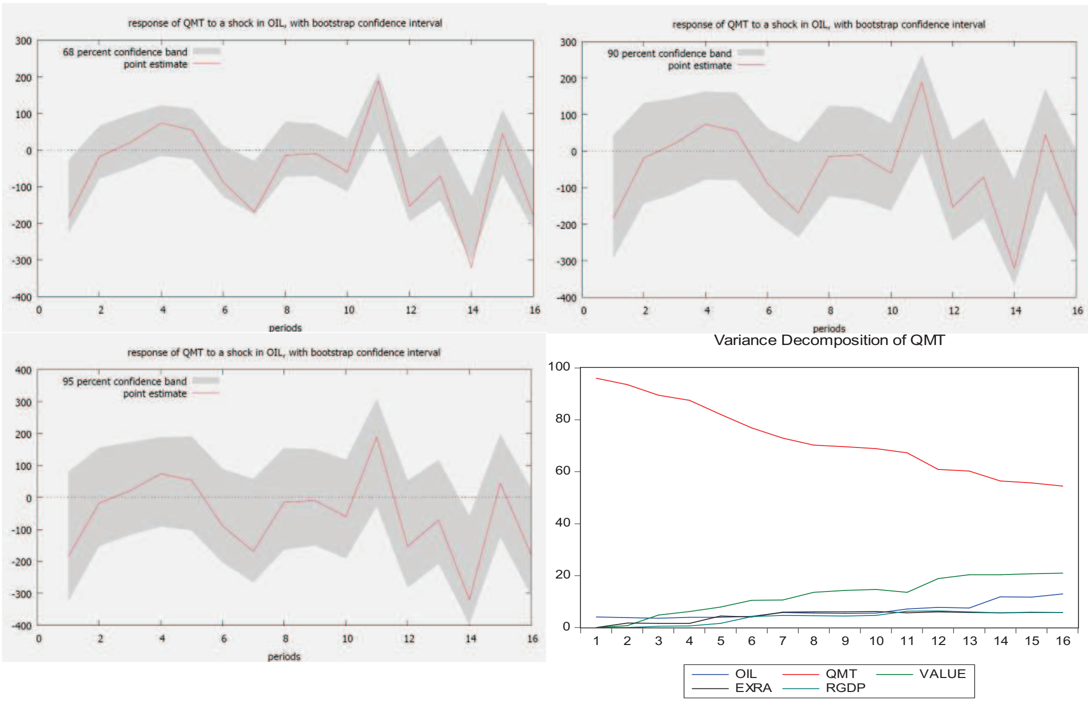
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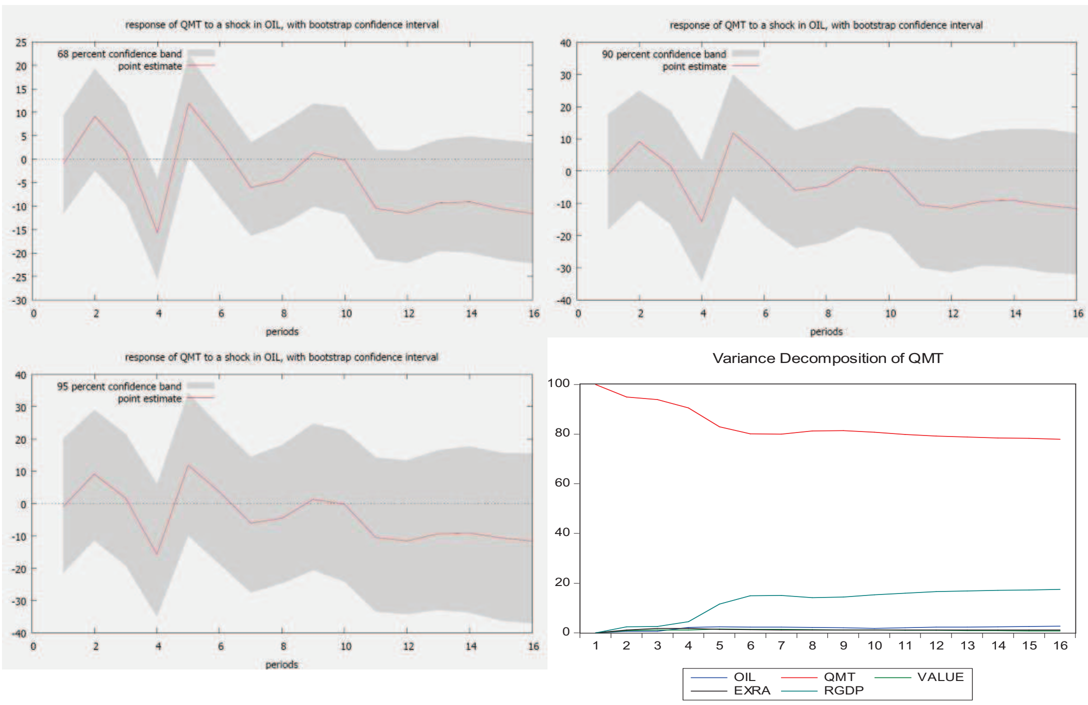
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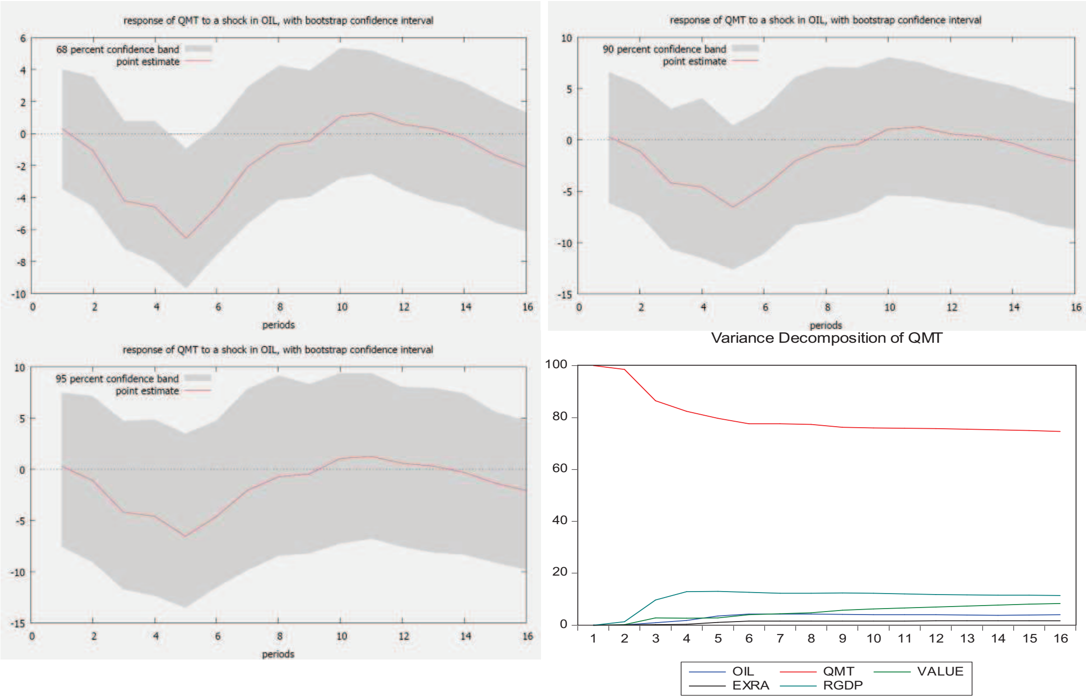
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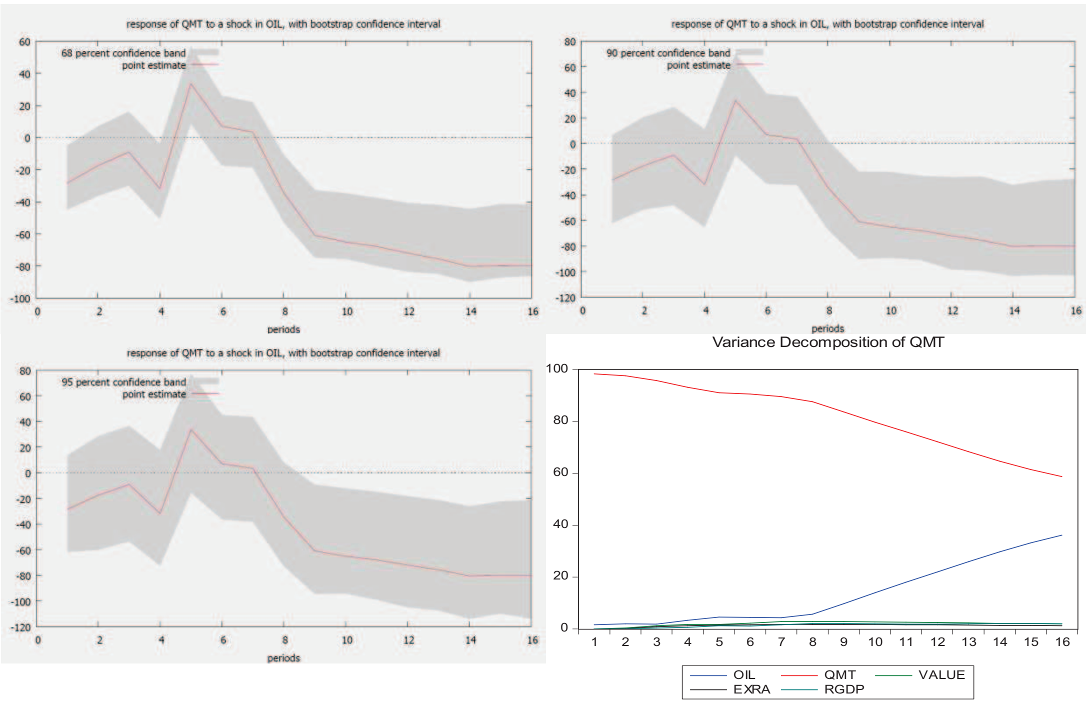
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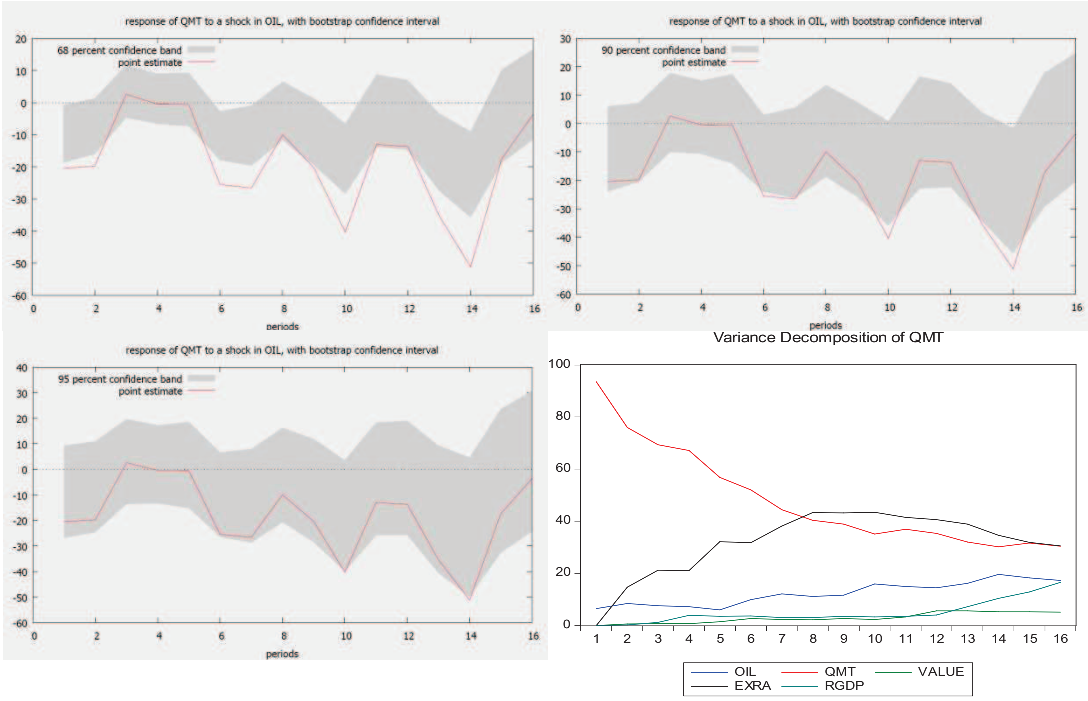
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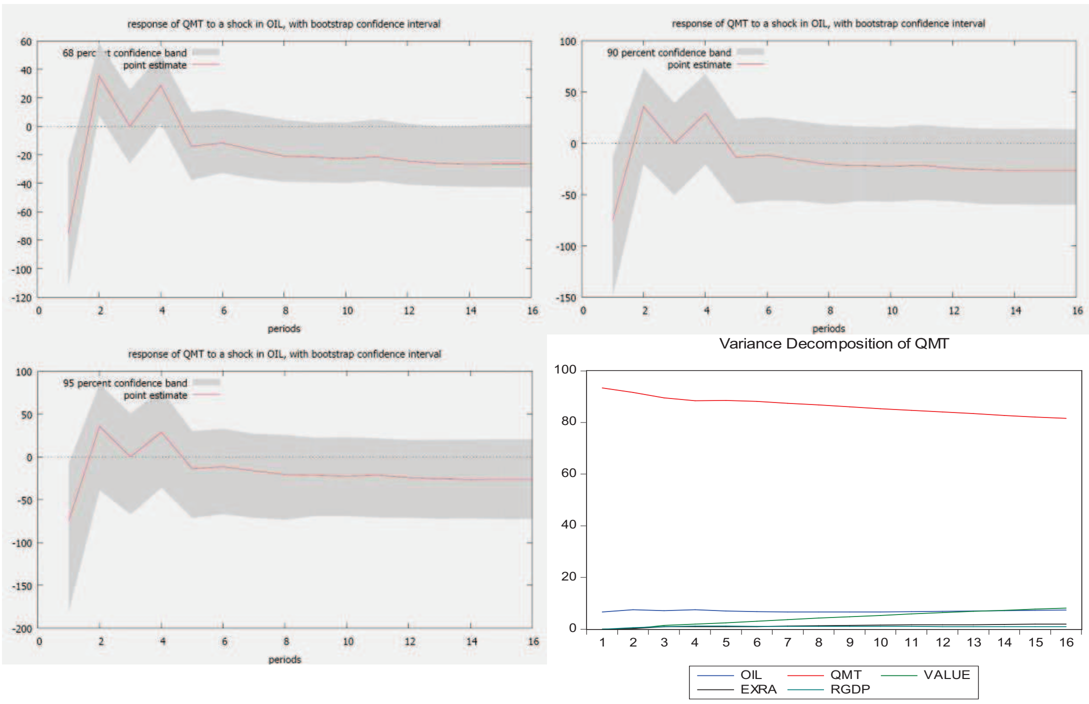
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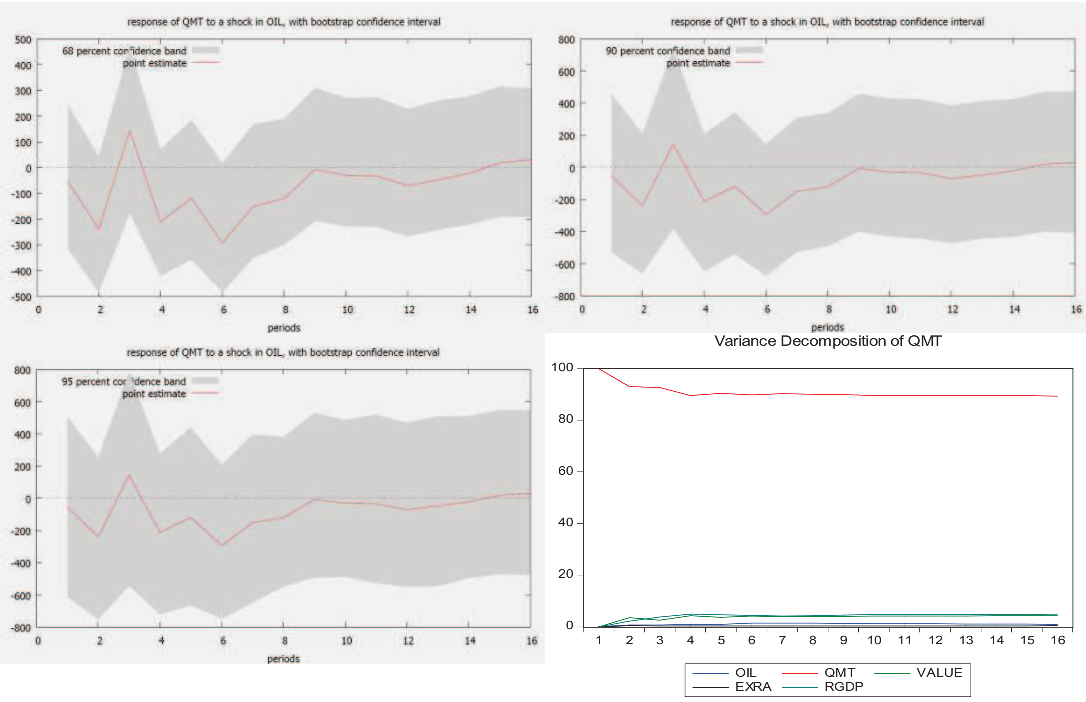
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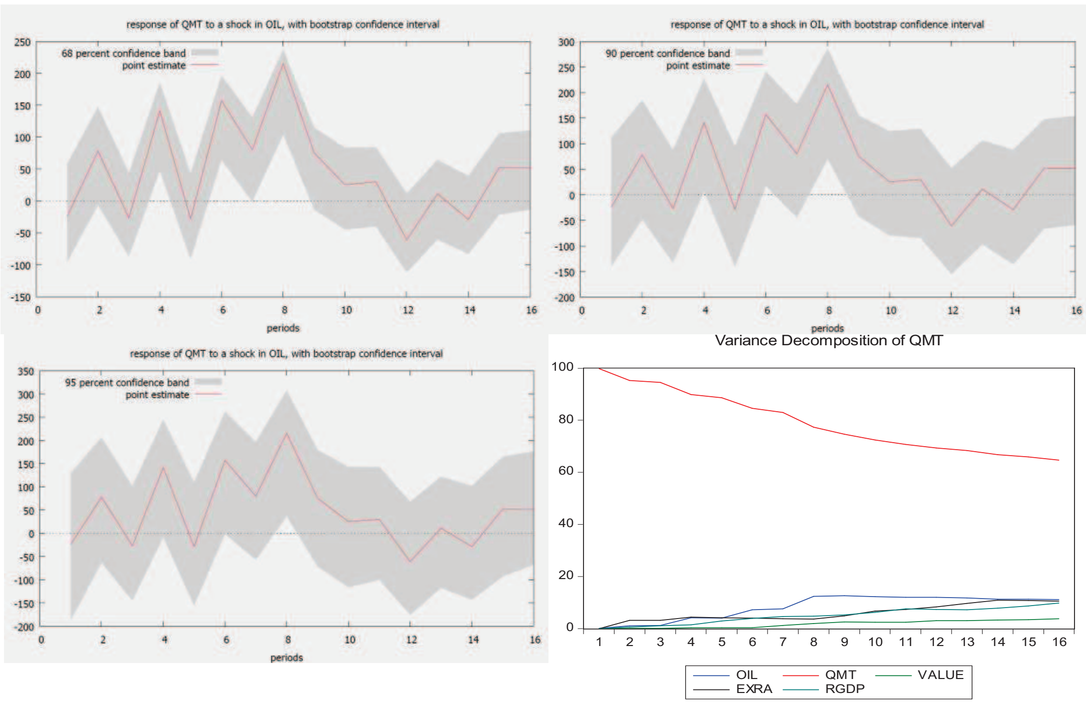
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RGDP

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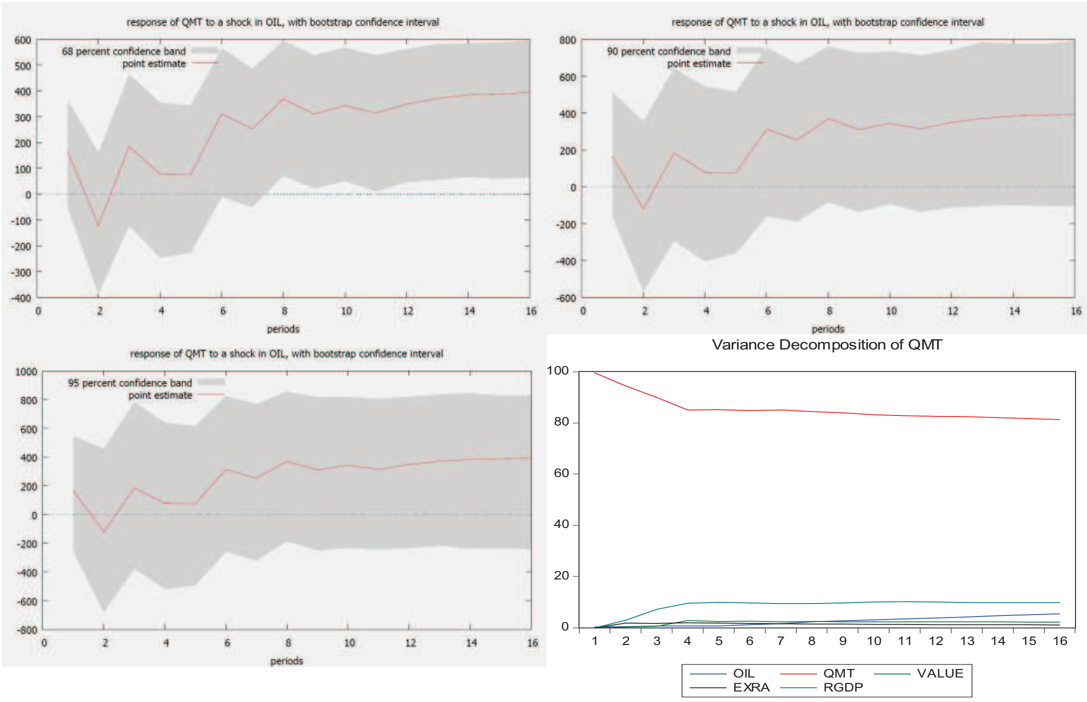
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periods
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periods
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OIL
QMT
VALUE
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RGDP

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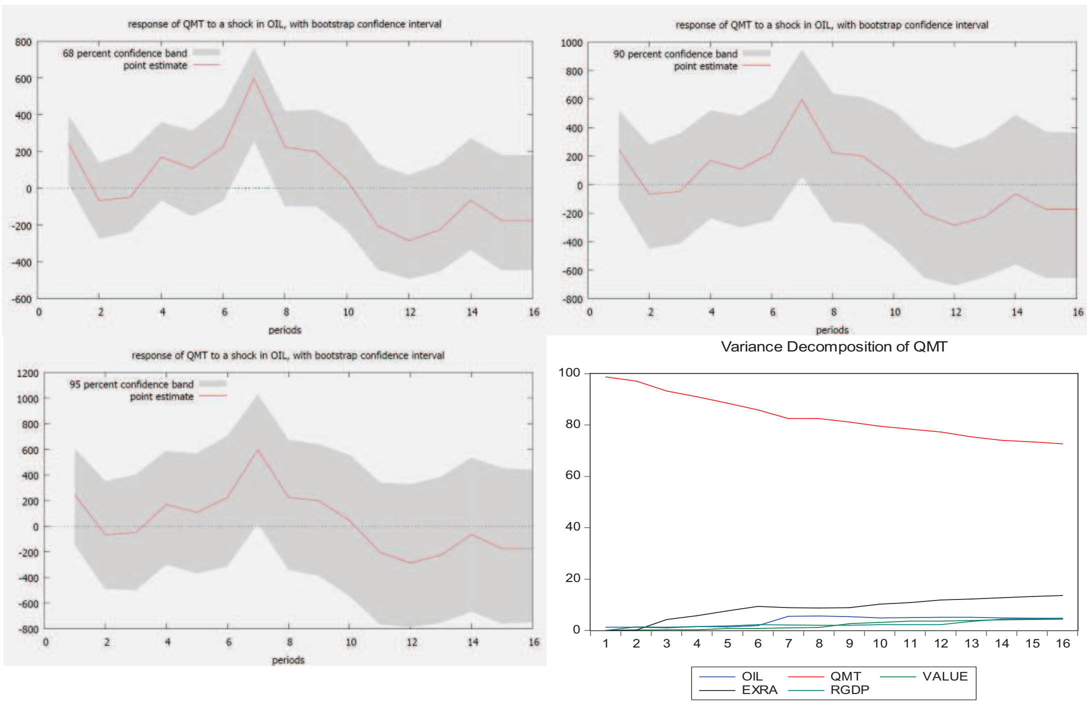
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OIL
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RGDP

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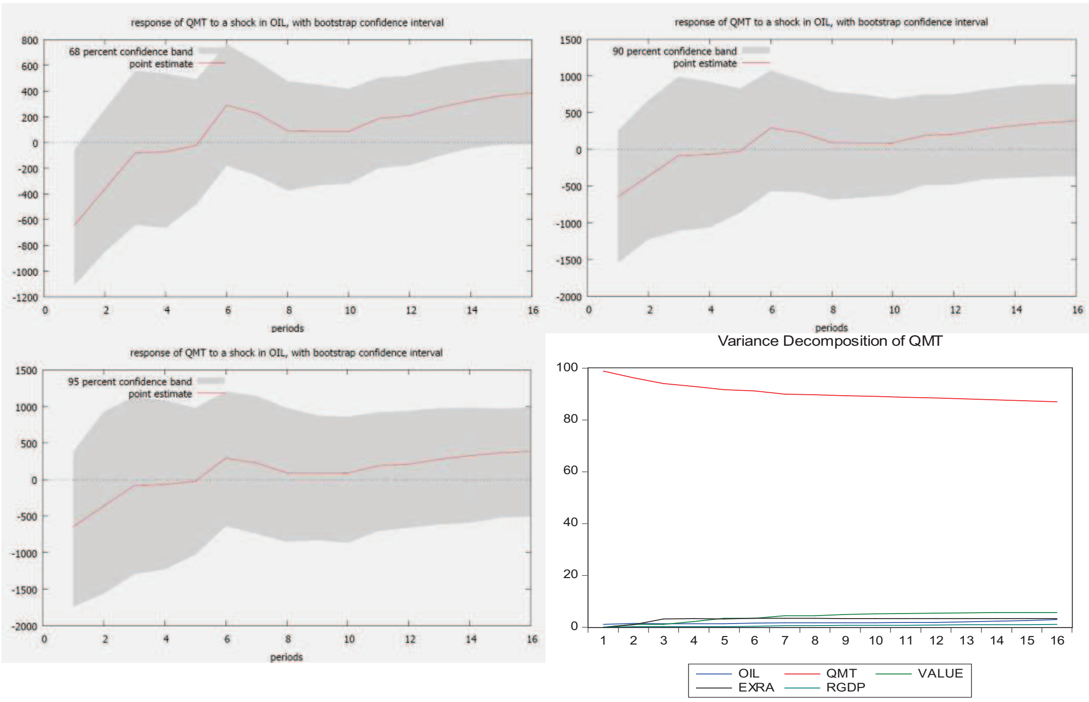
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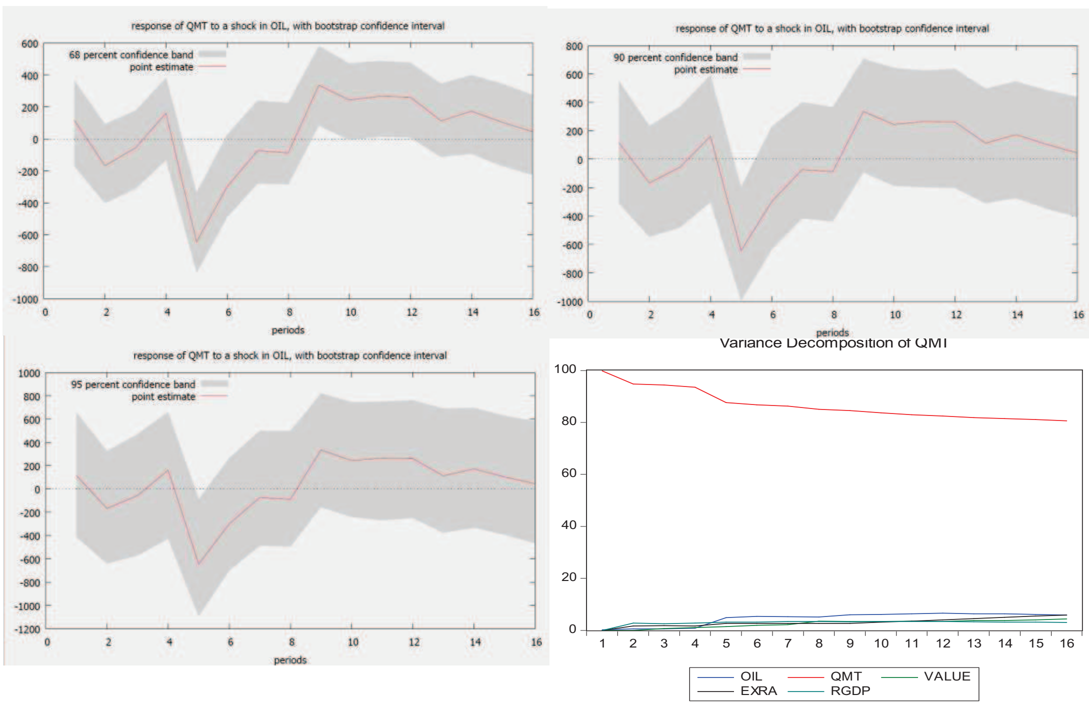
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Variance Decomposition of QMT
OIL
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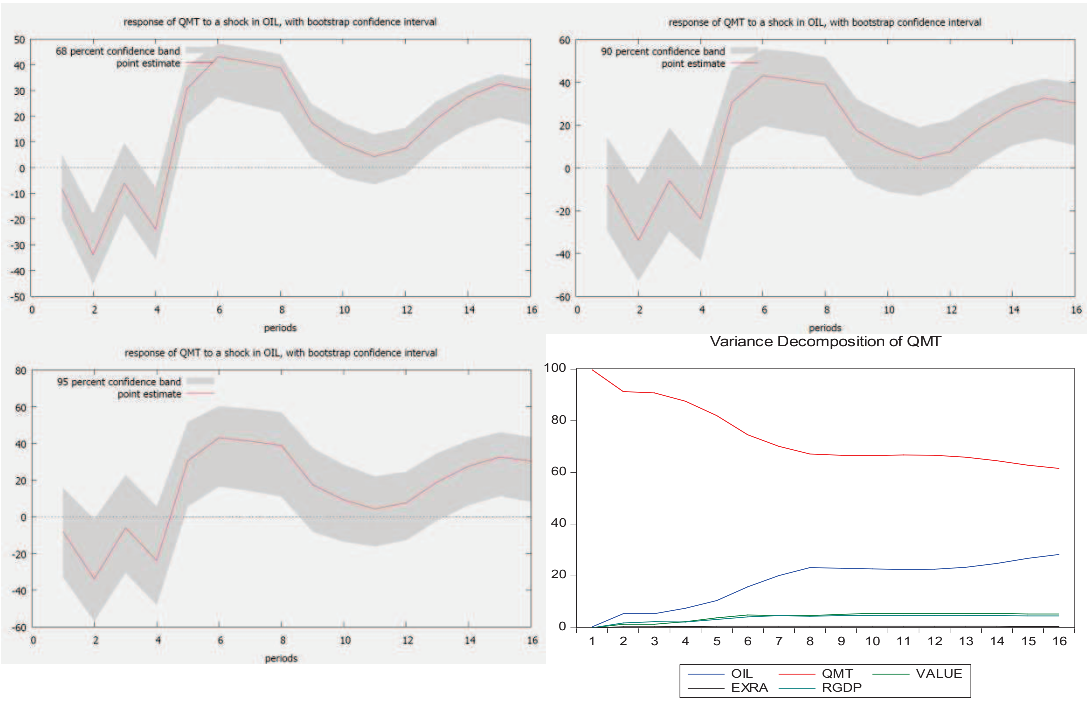
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OIL
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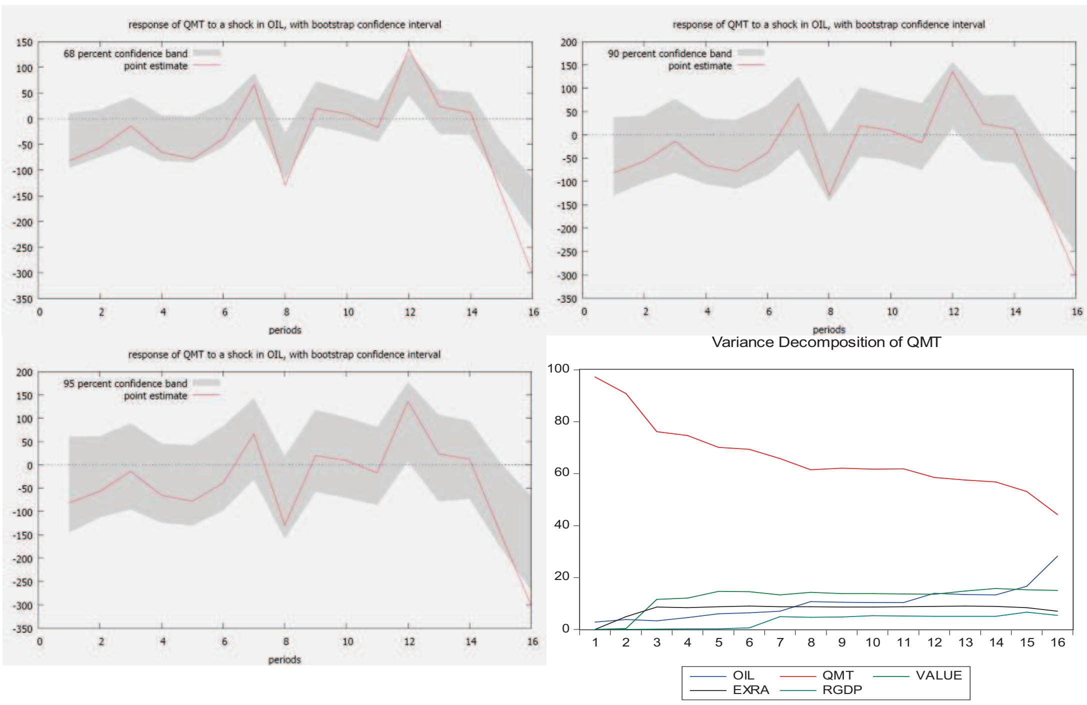
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OIL
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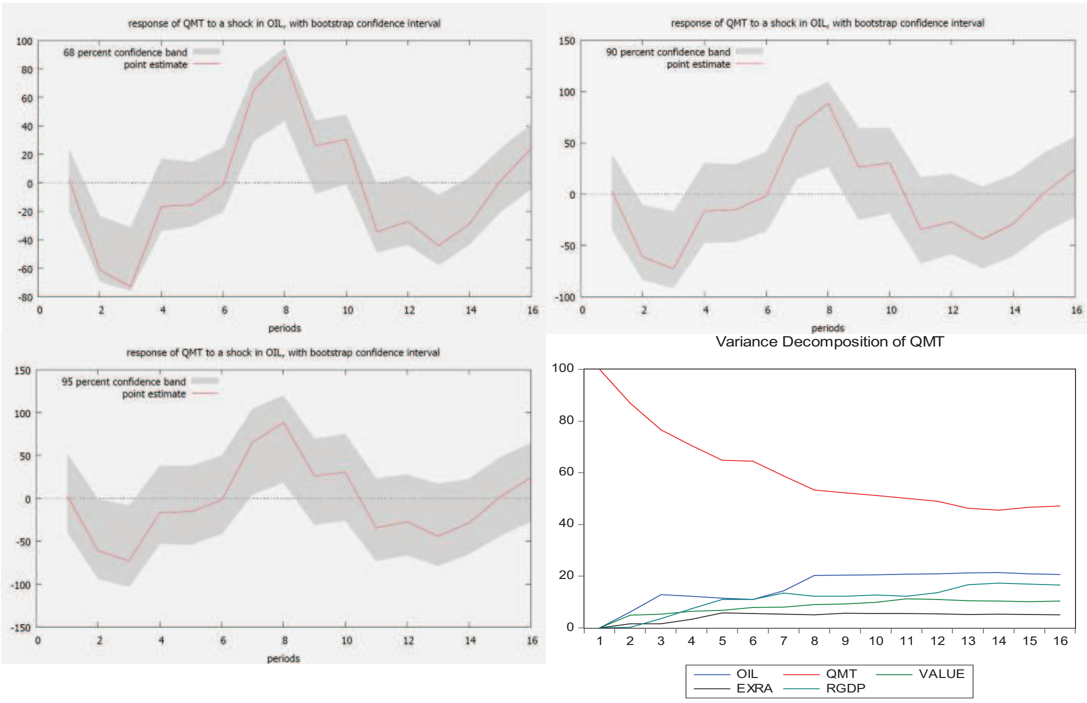
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Variance Decomposition of QMT
OIL
QMT
VALUE
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RGDP

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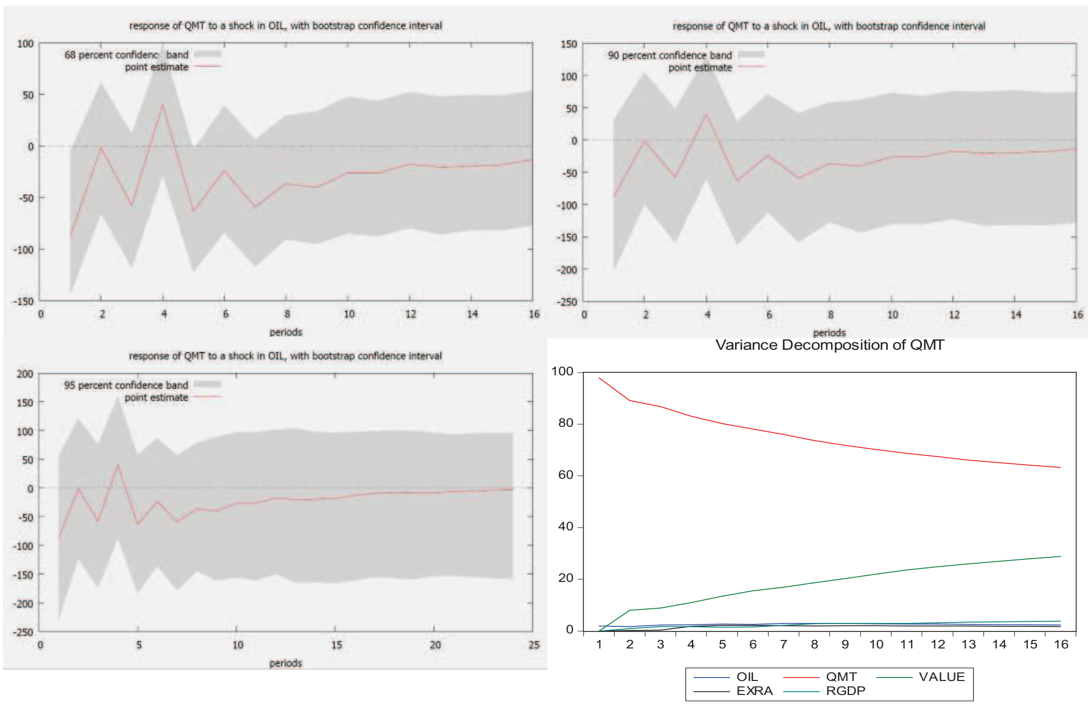
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QMT
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4.2.1.4 Italy

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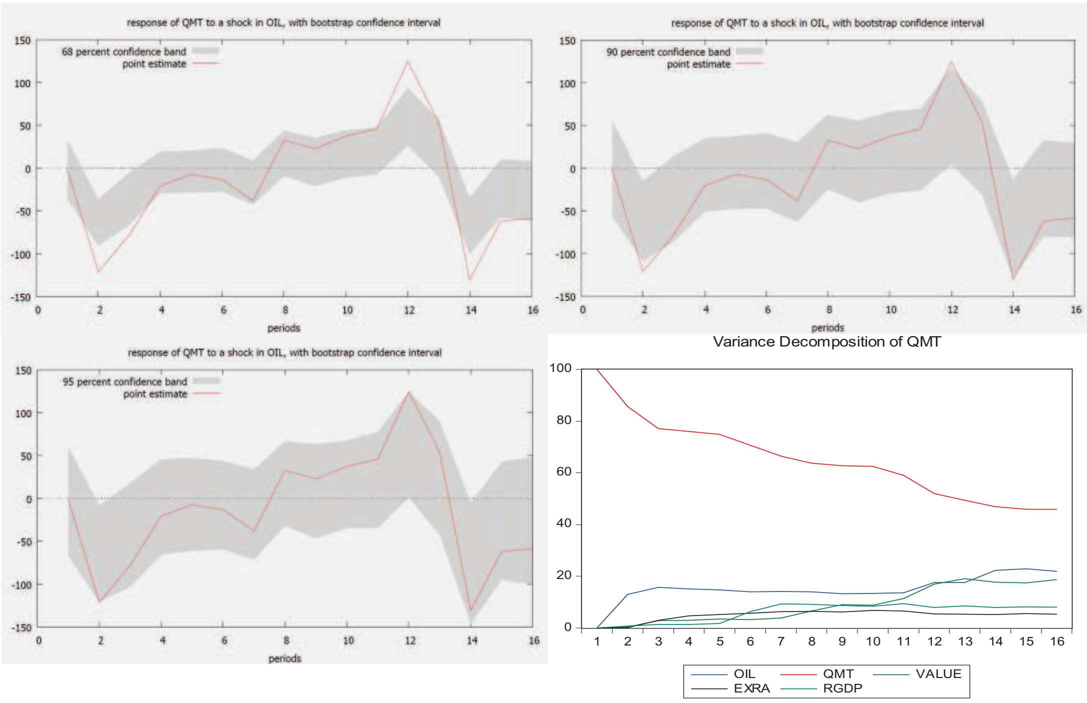

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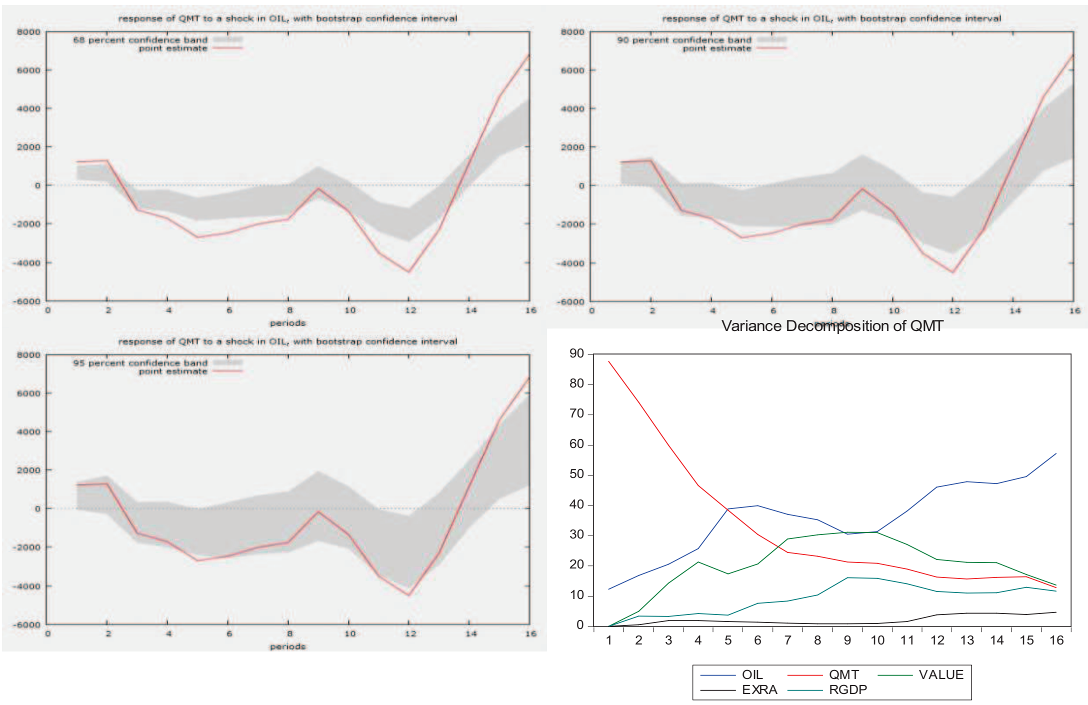

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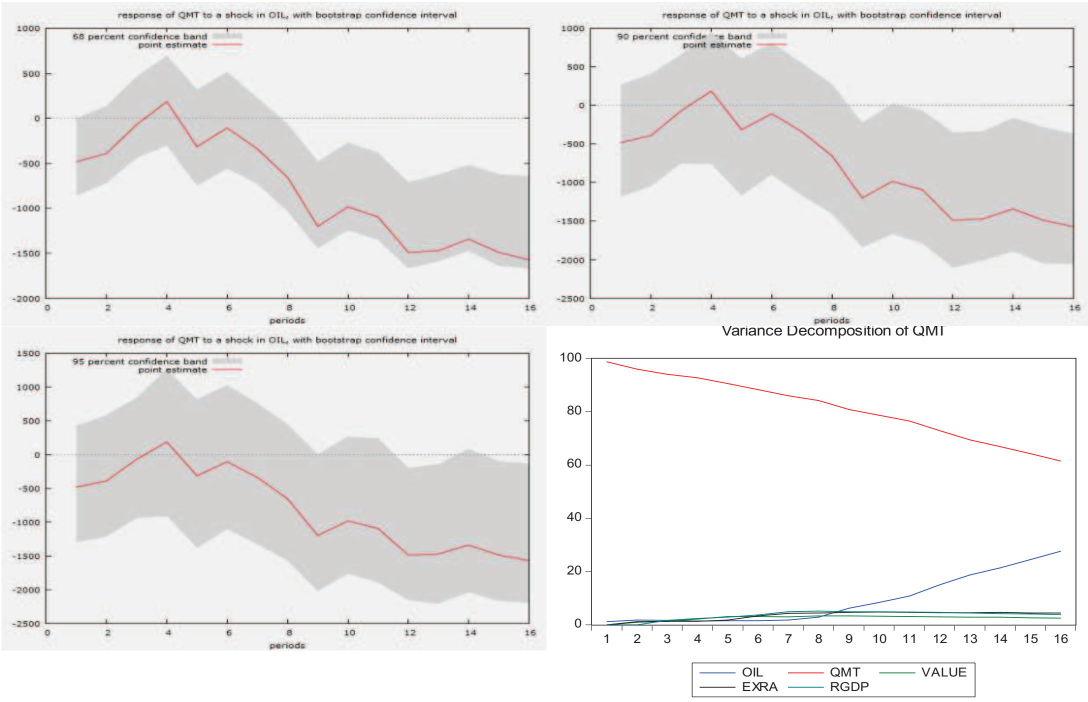
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OIL
QMT
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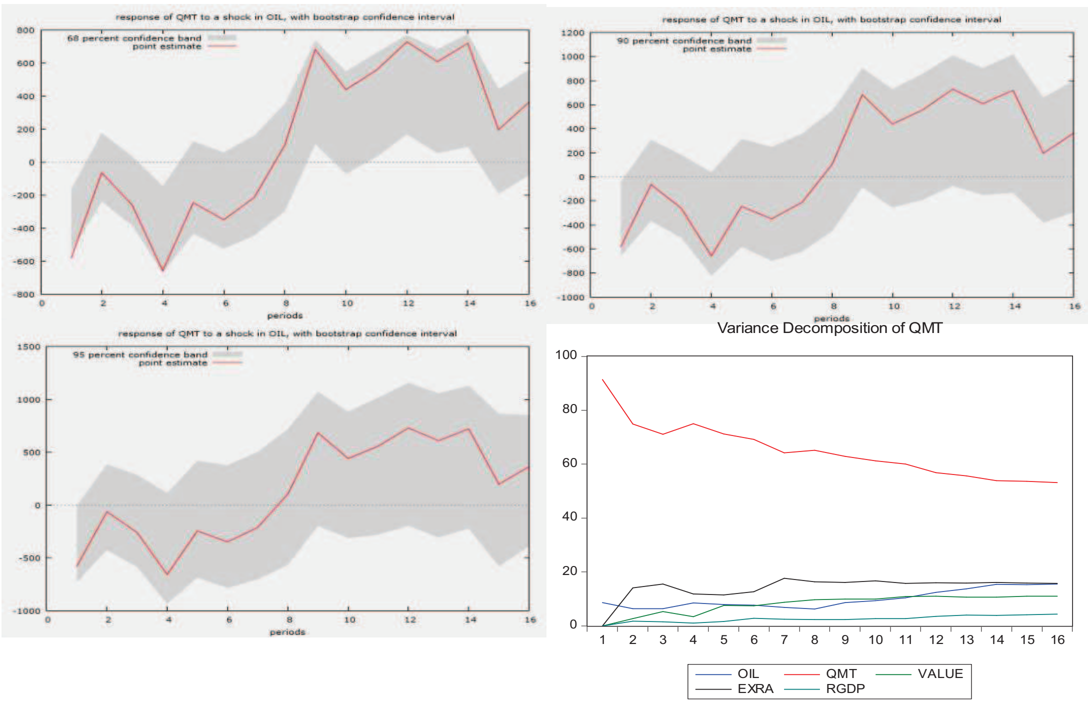
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OIL
QMT
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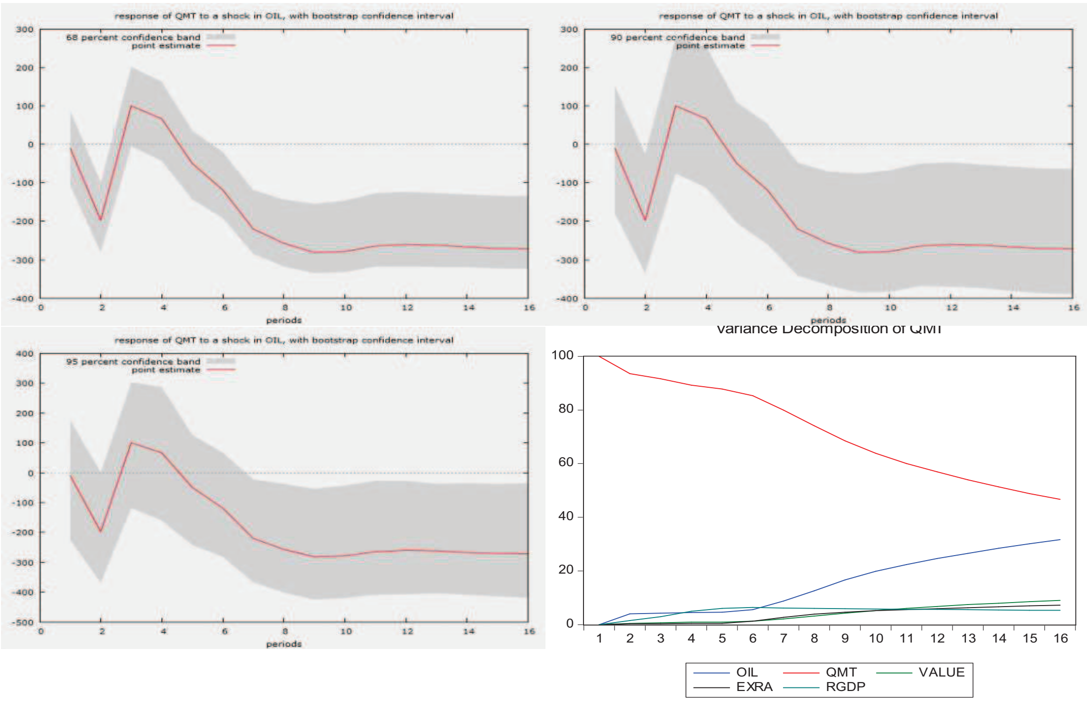
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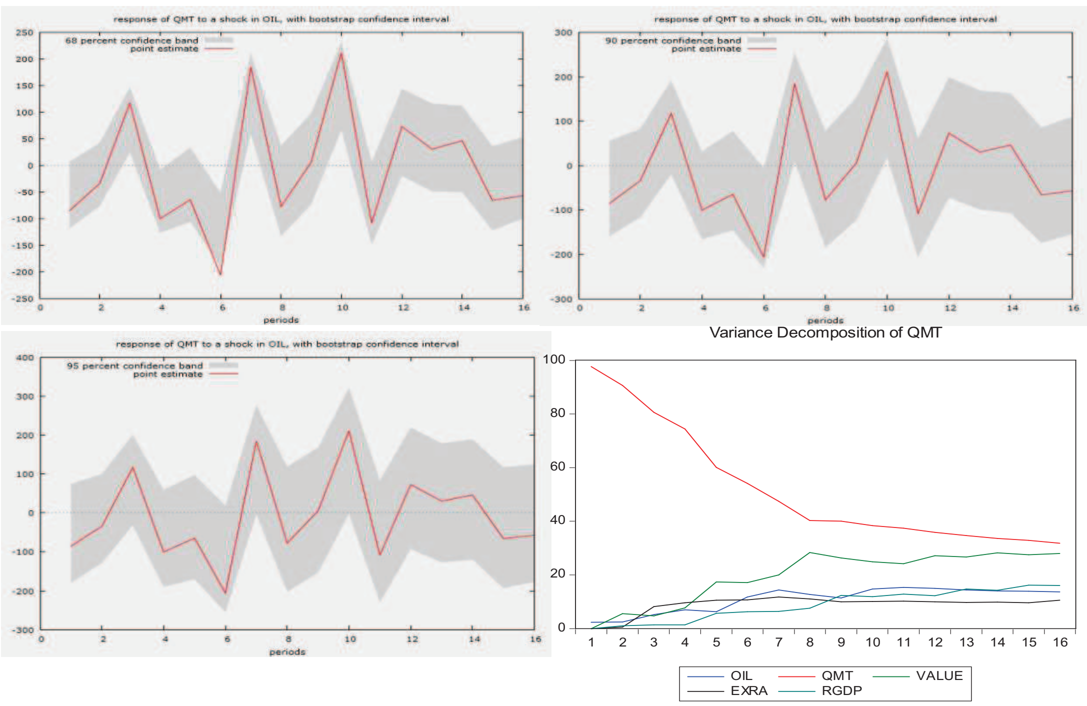
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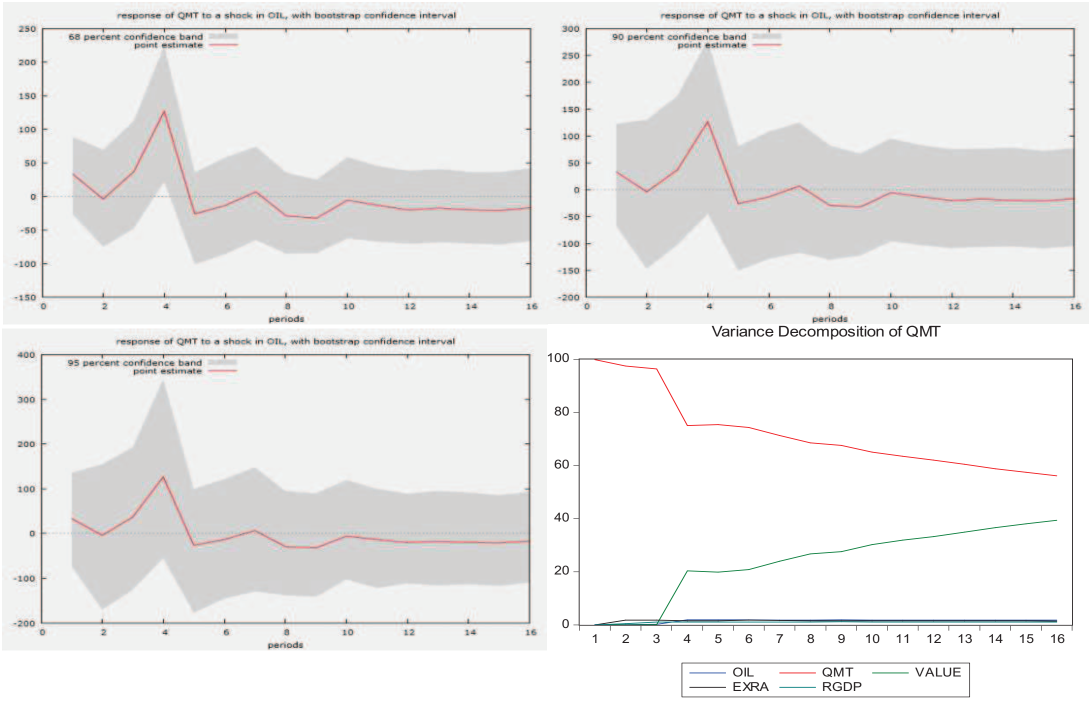
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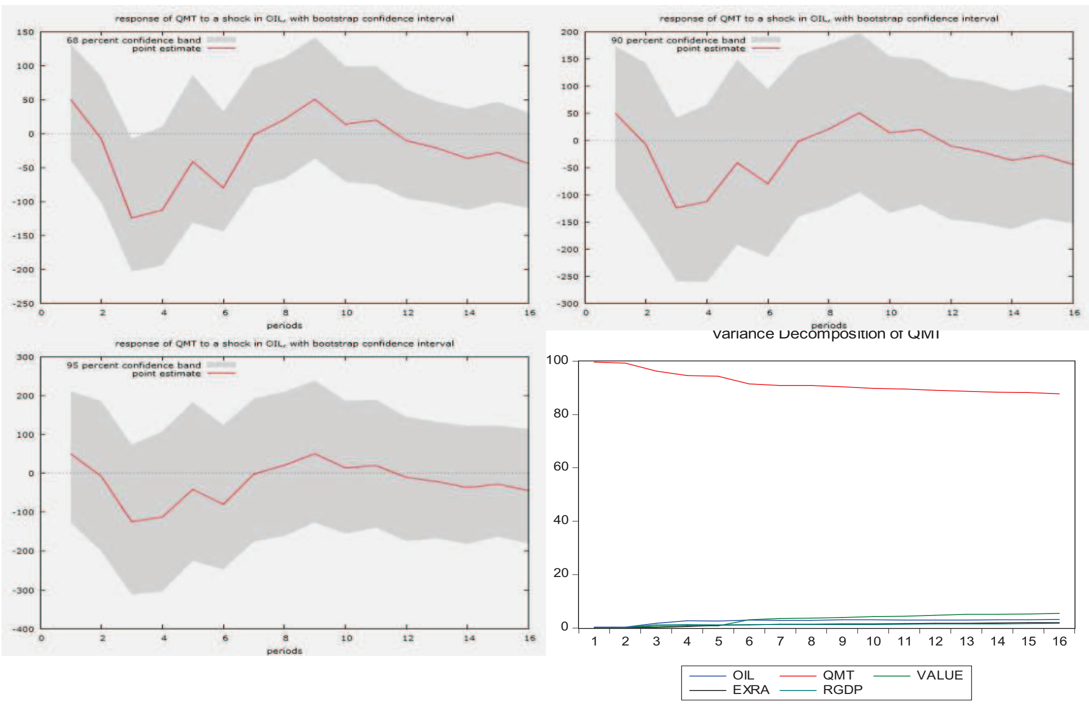
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OIL
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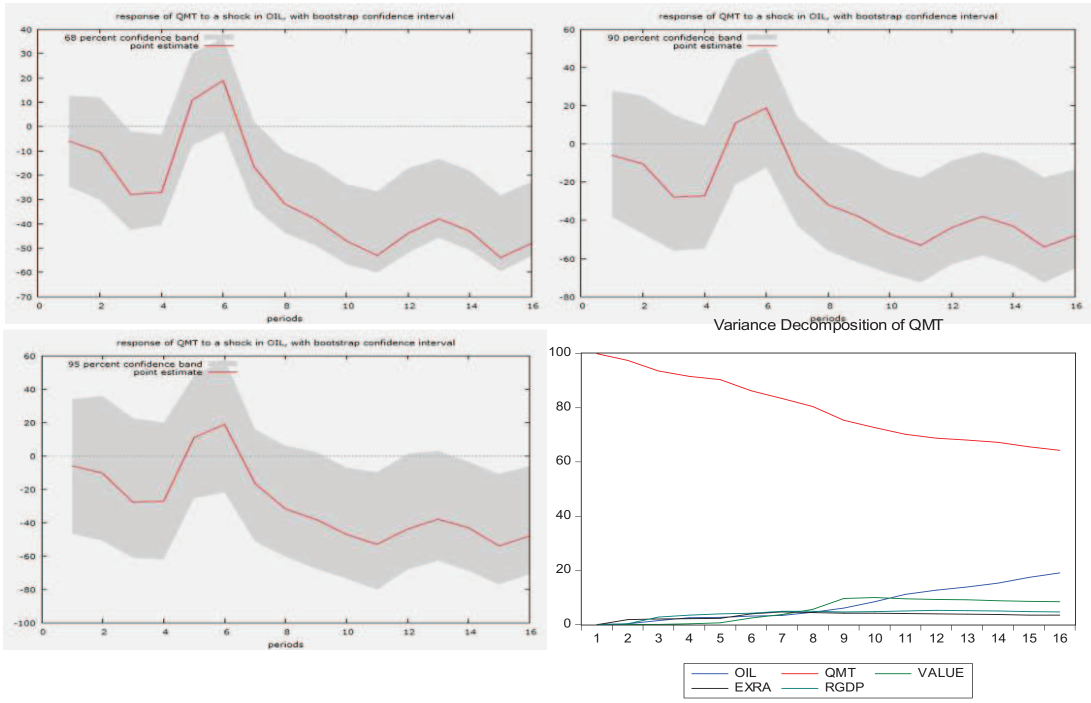
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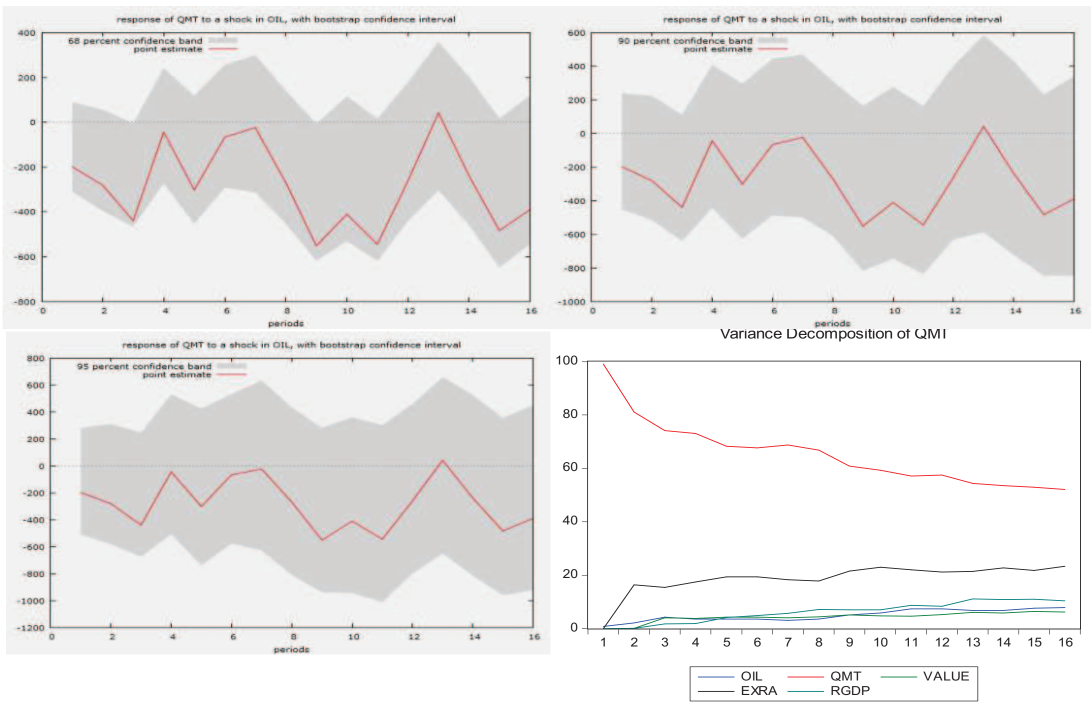
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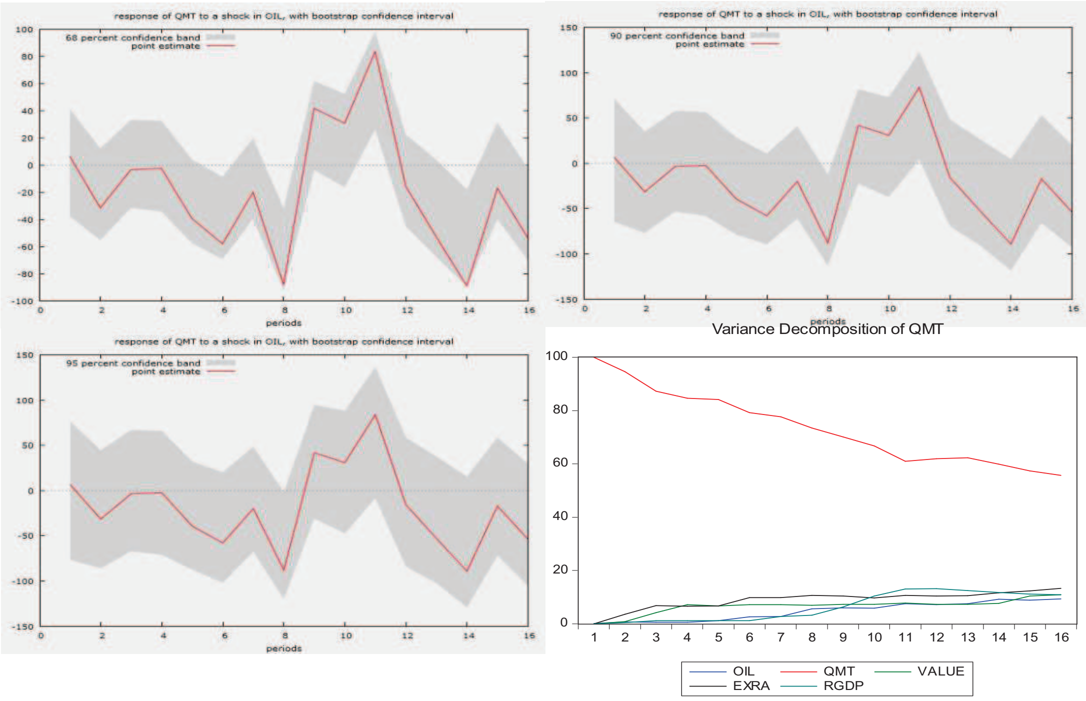
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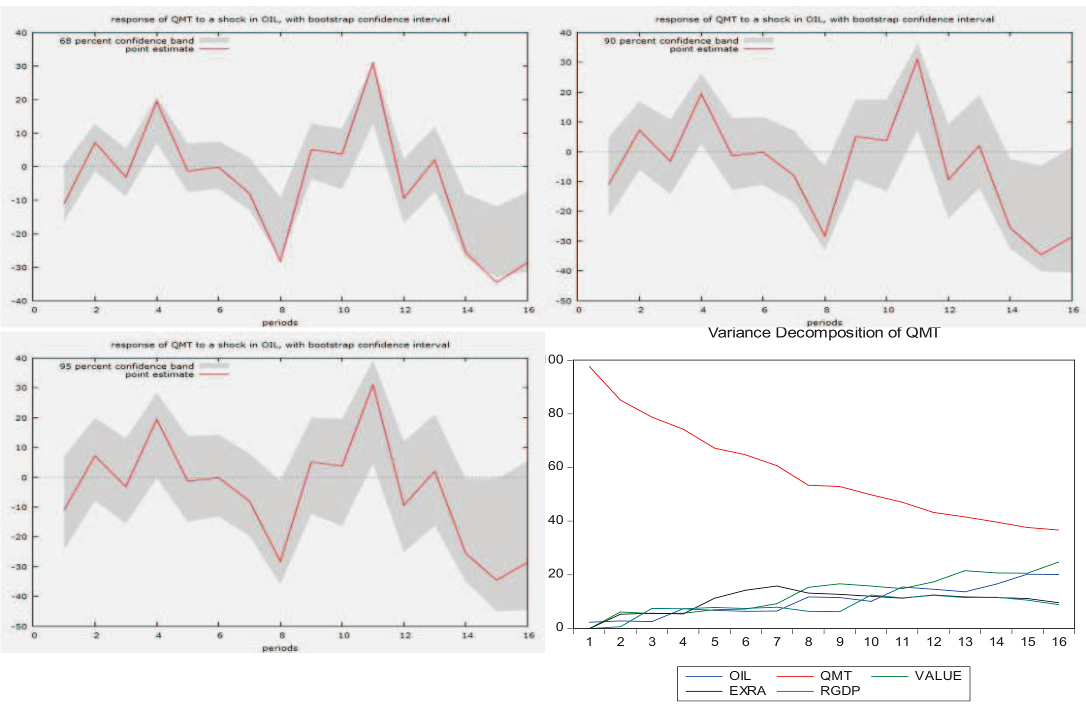
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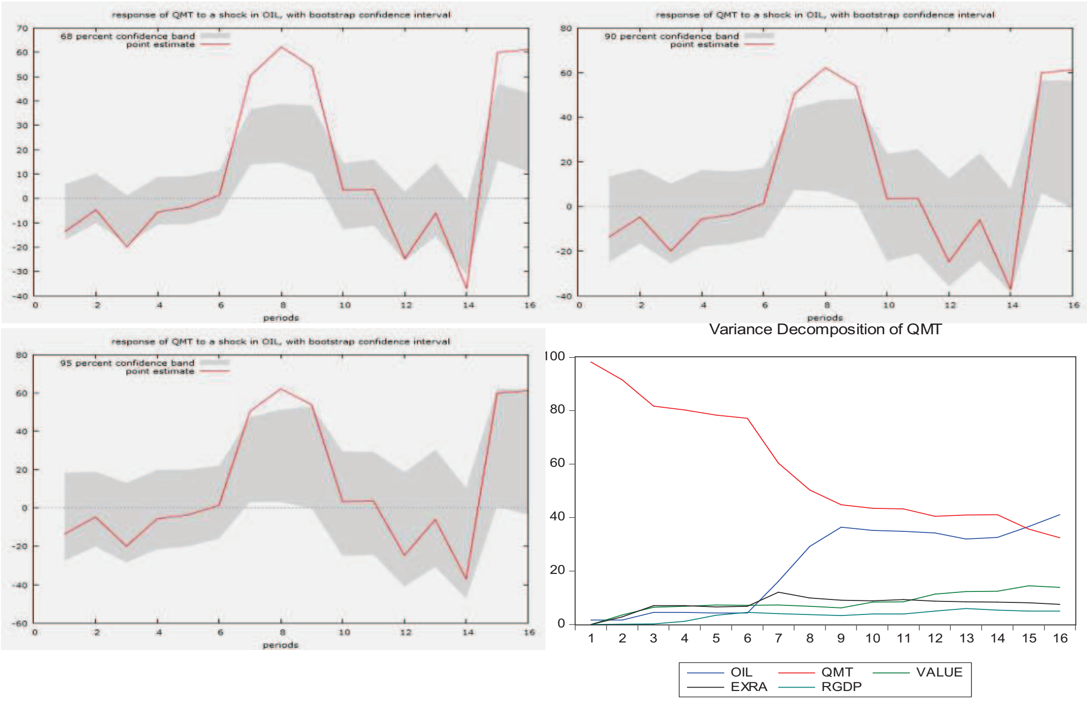
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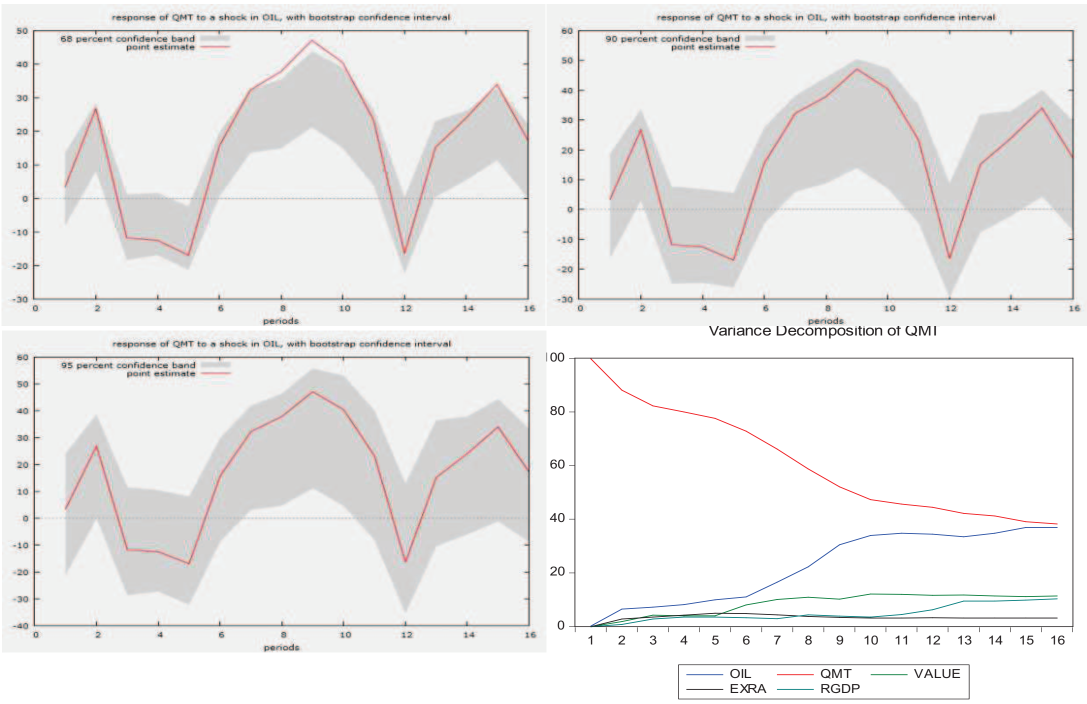
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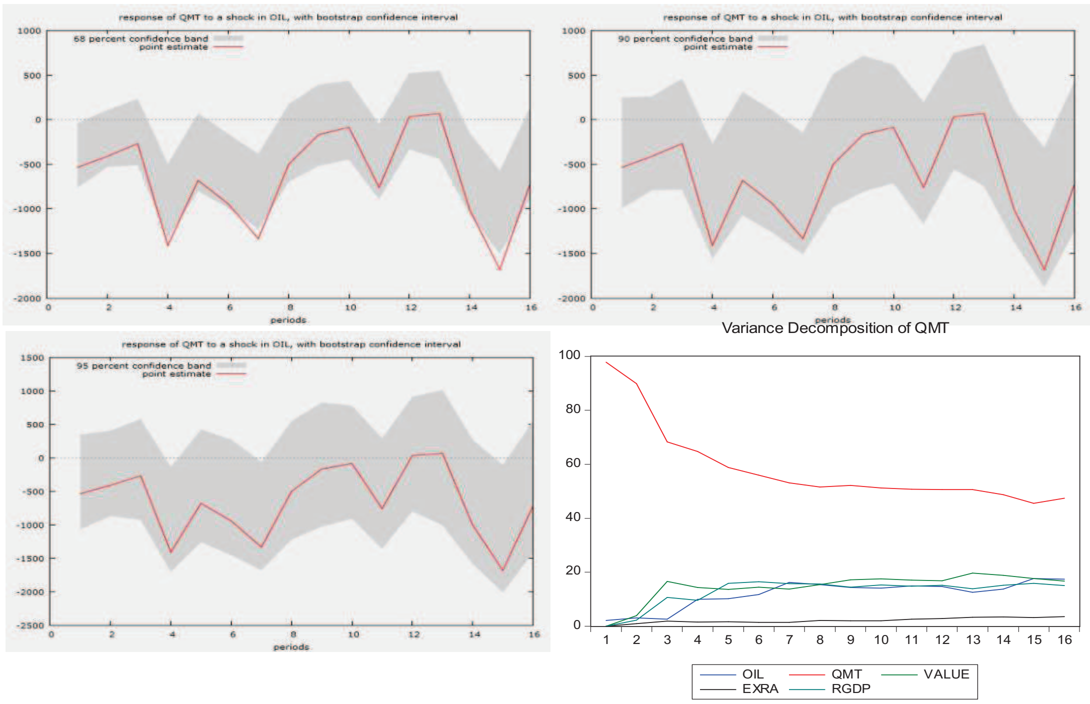
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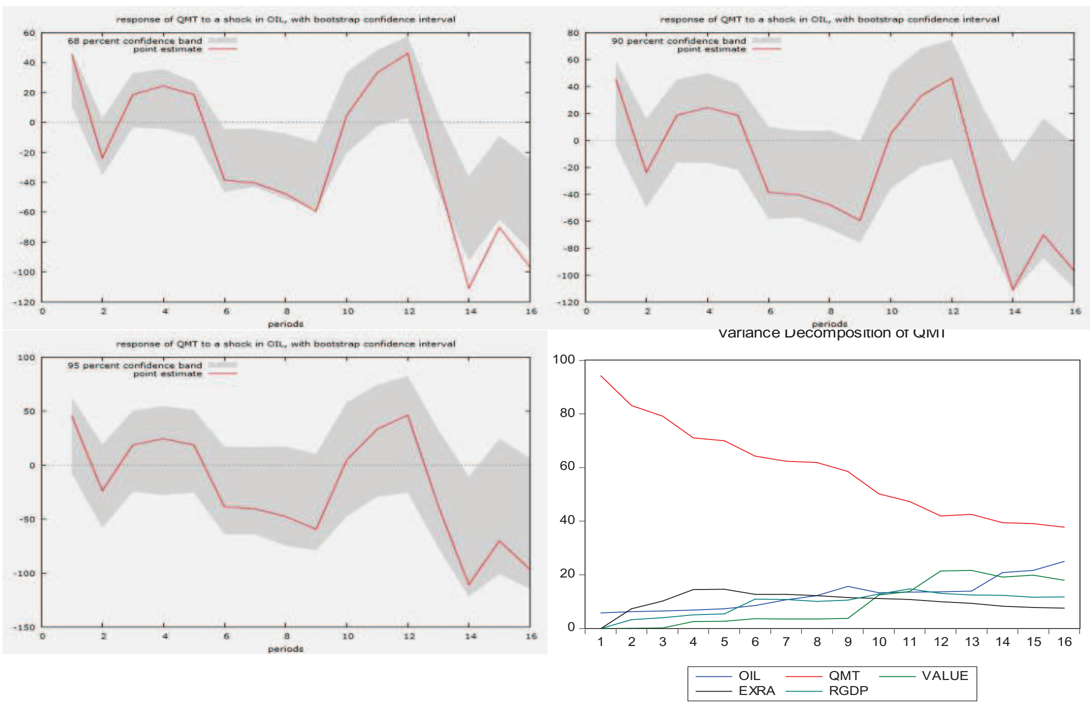
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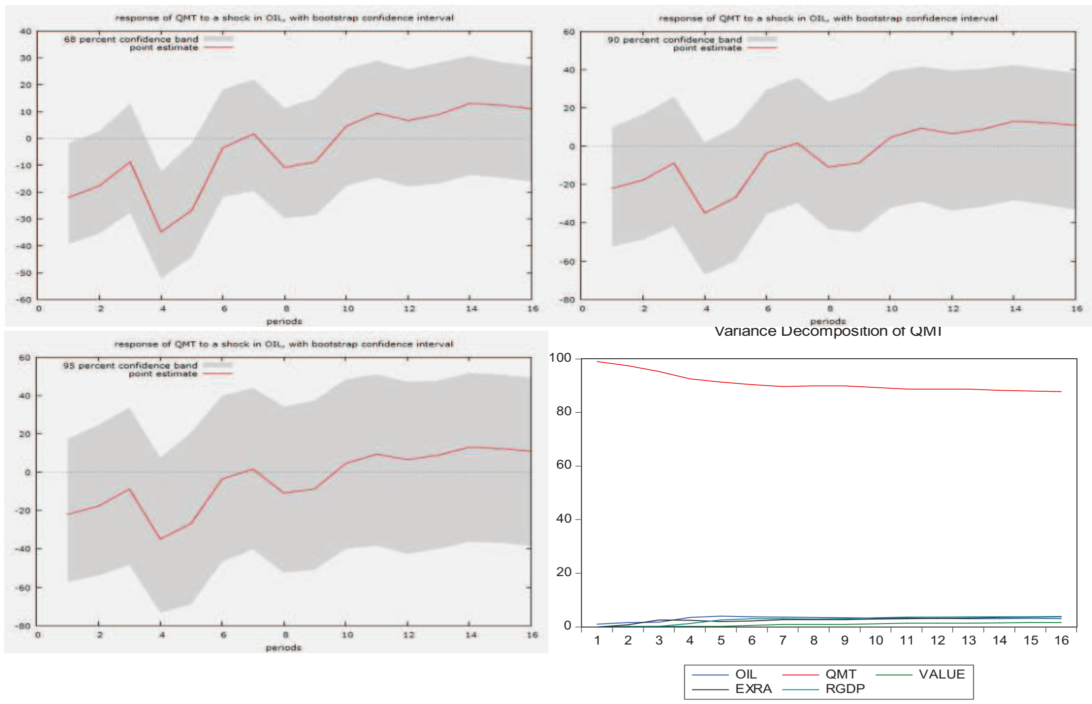
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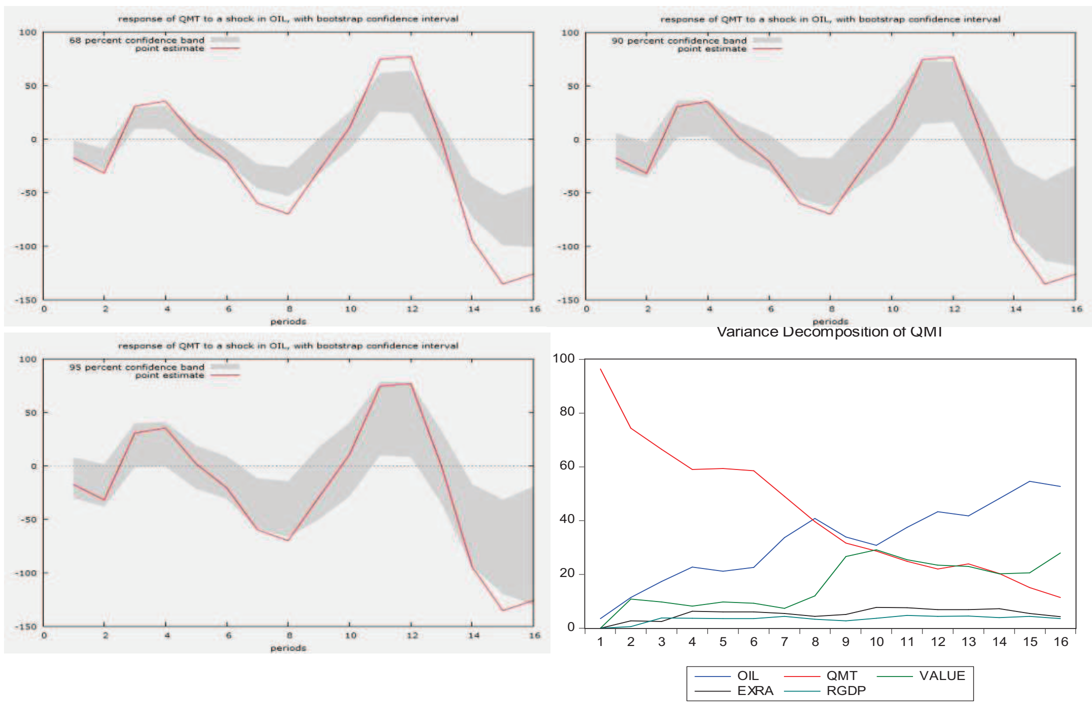
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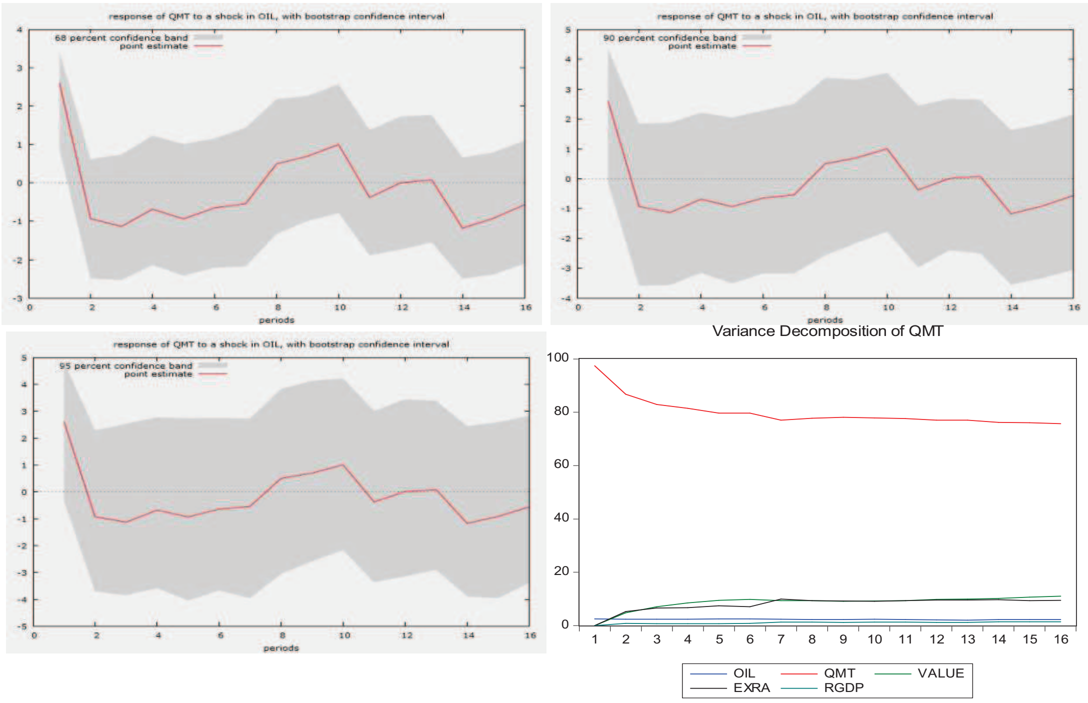
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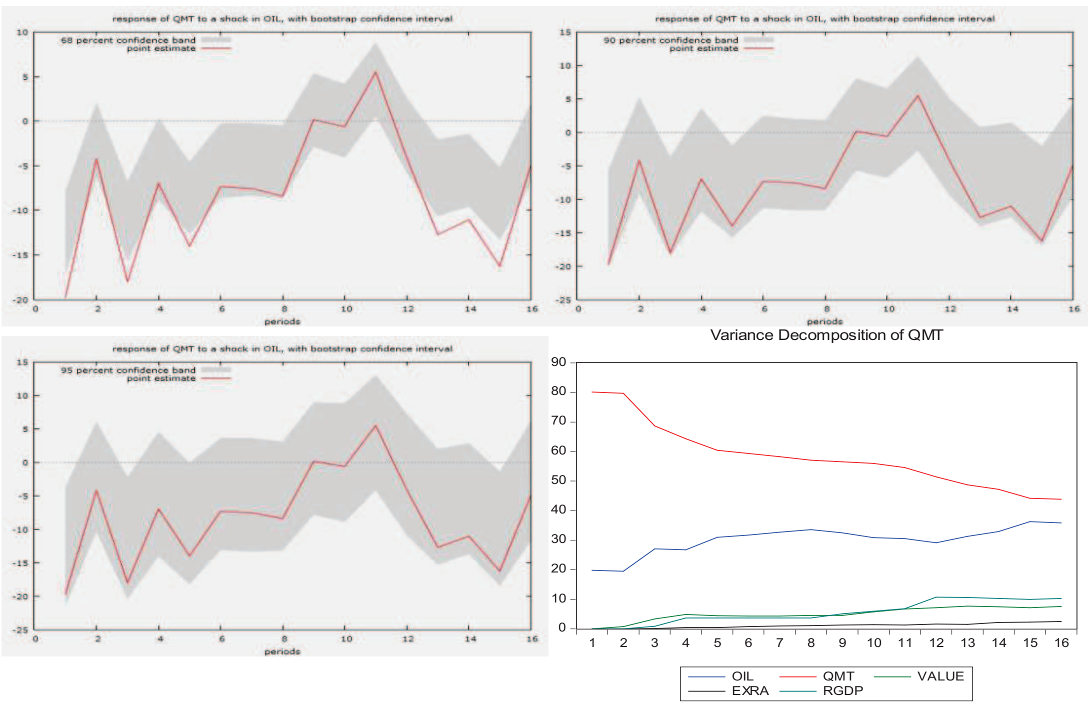
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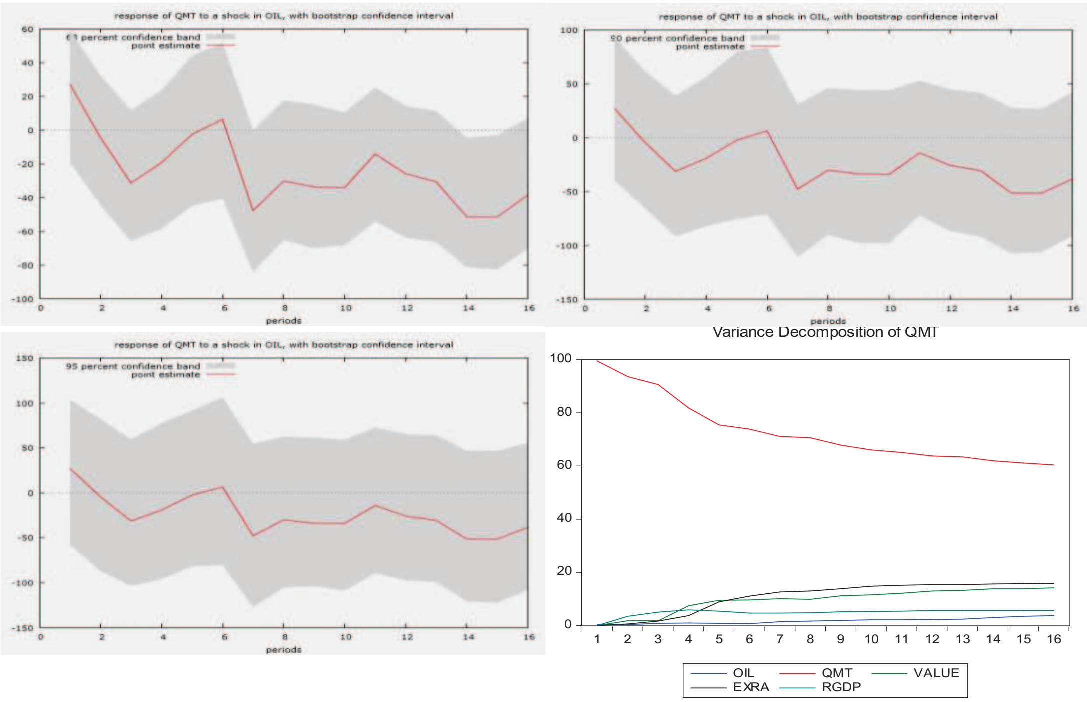
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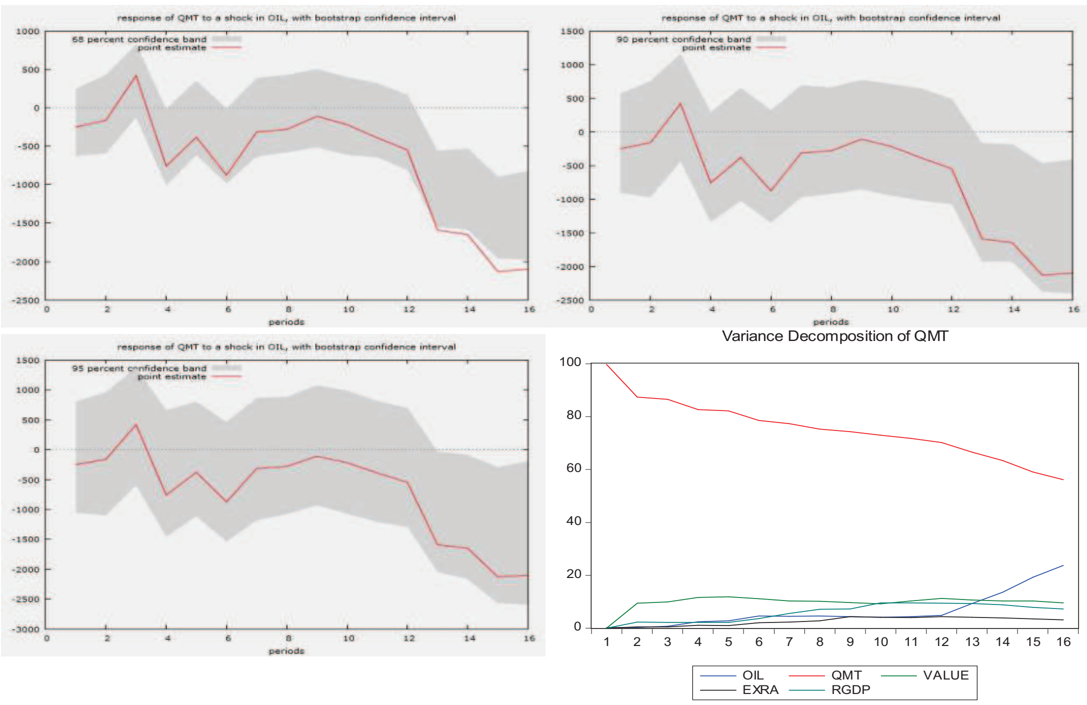
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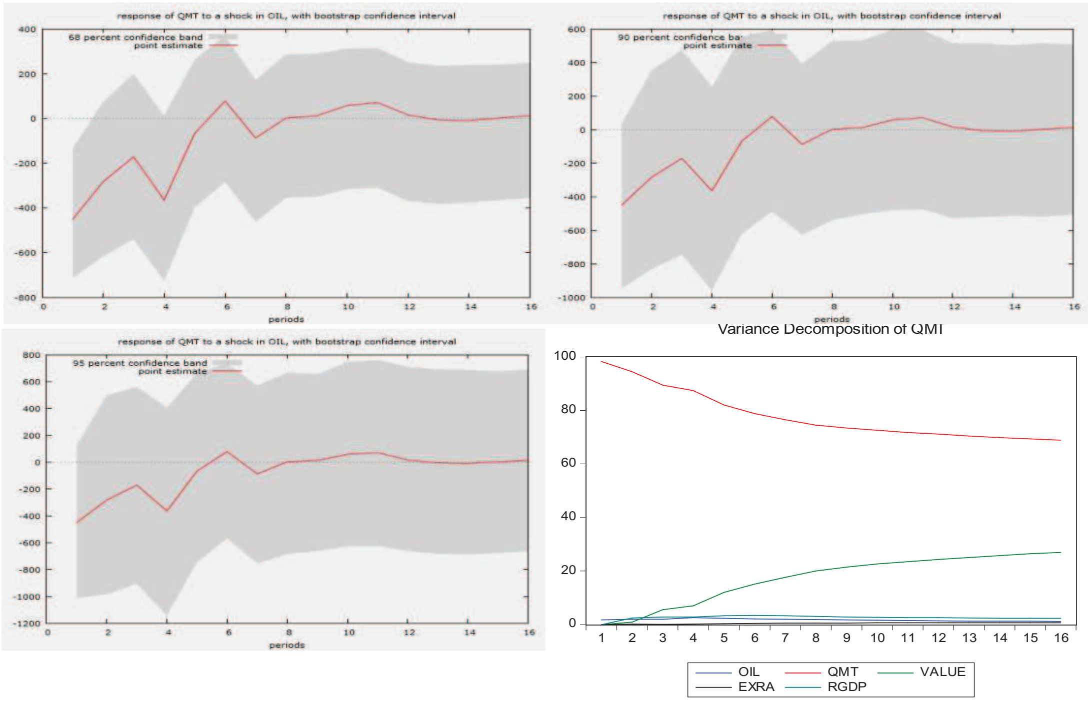
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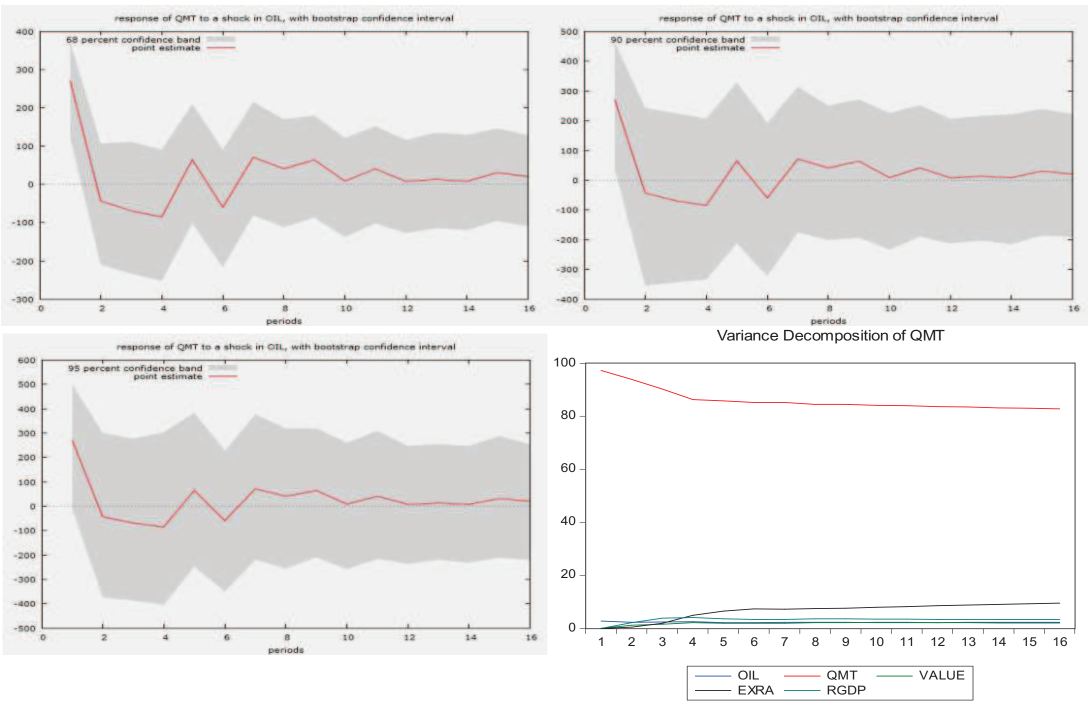
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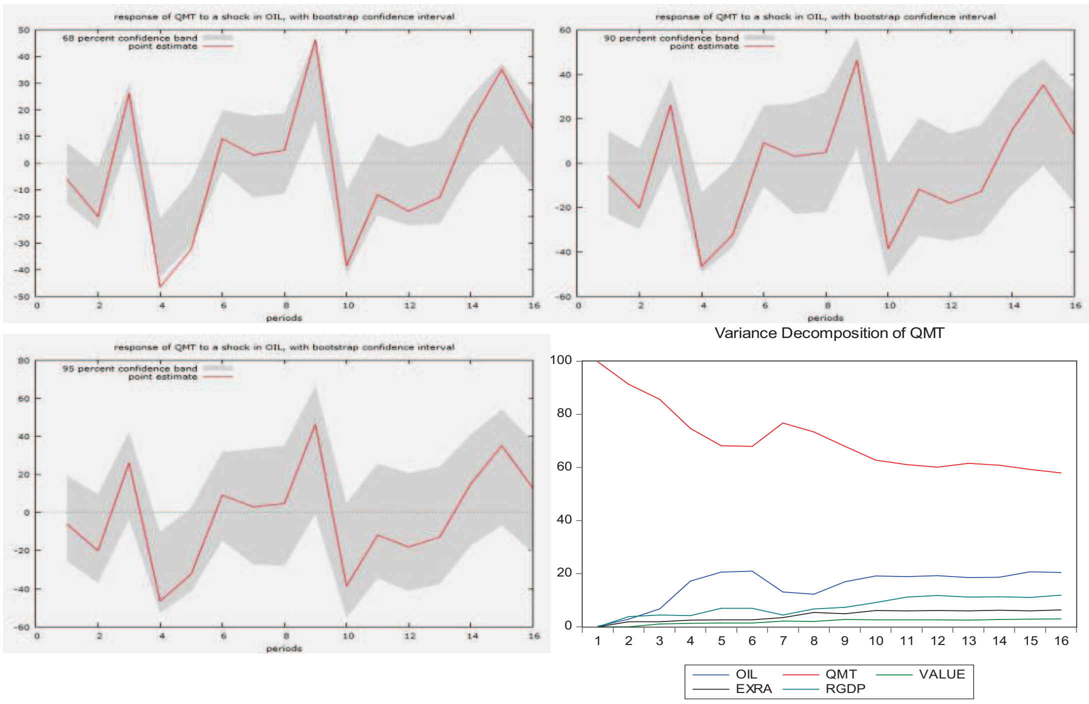
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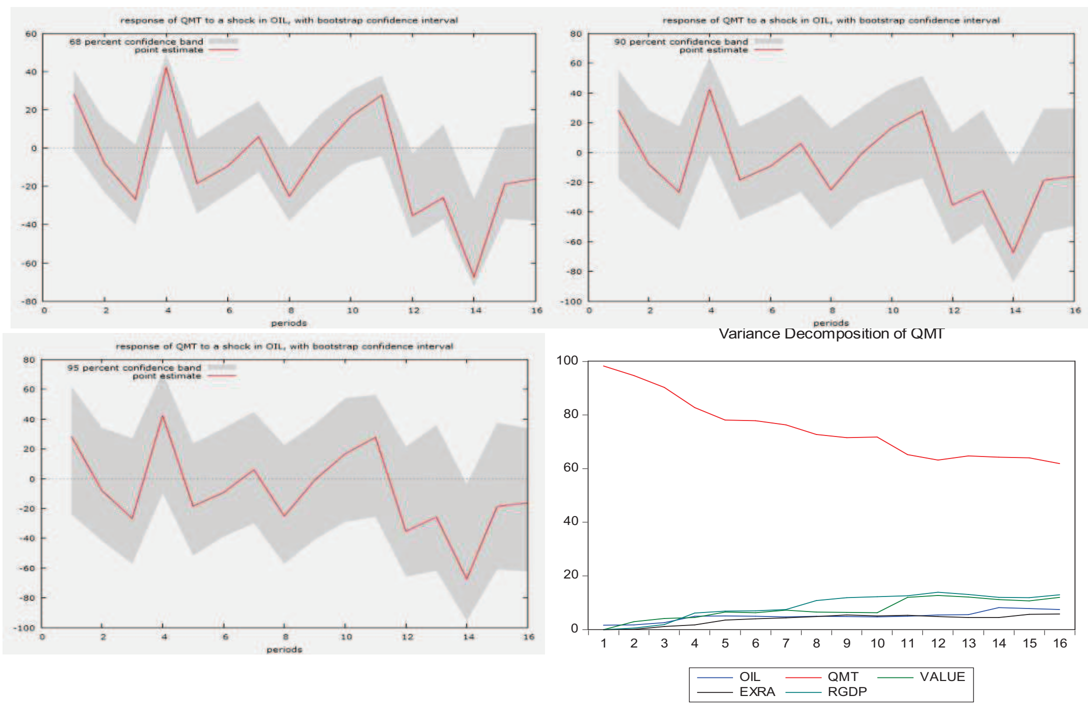
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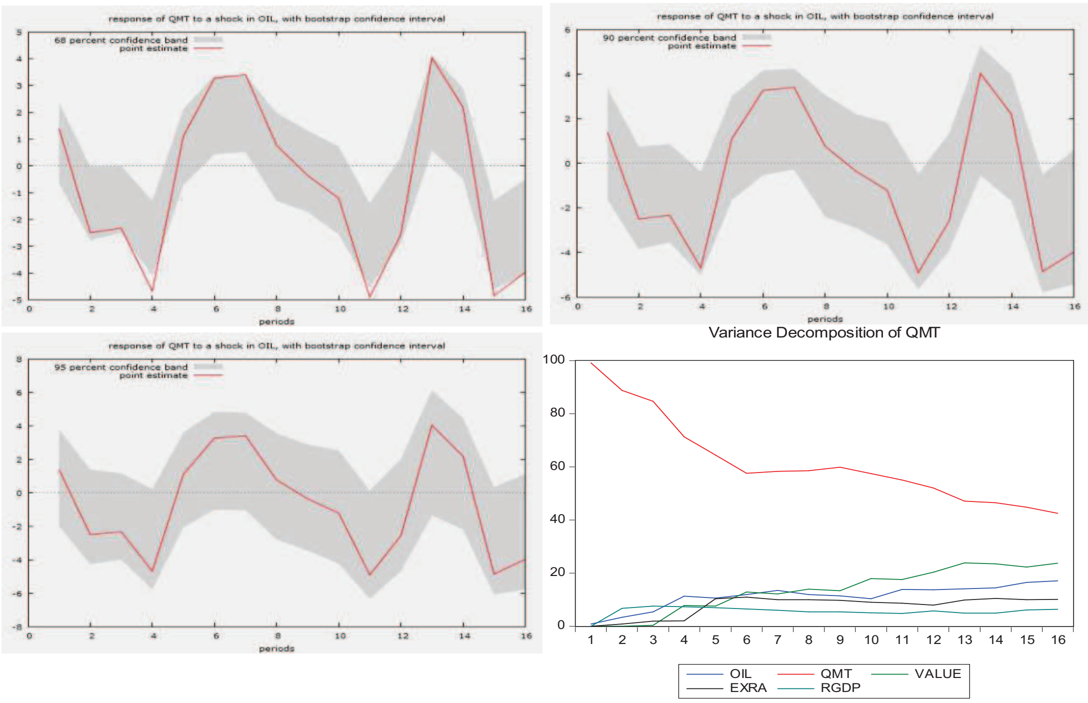
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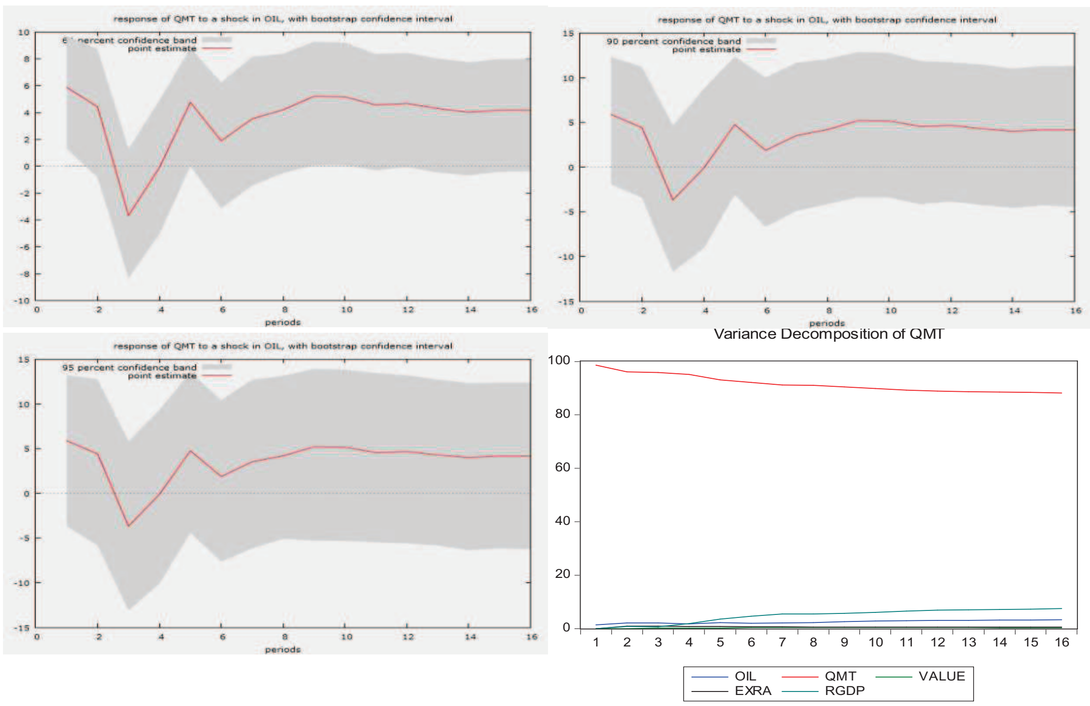
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4.2.1.5 Netherlands

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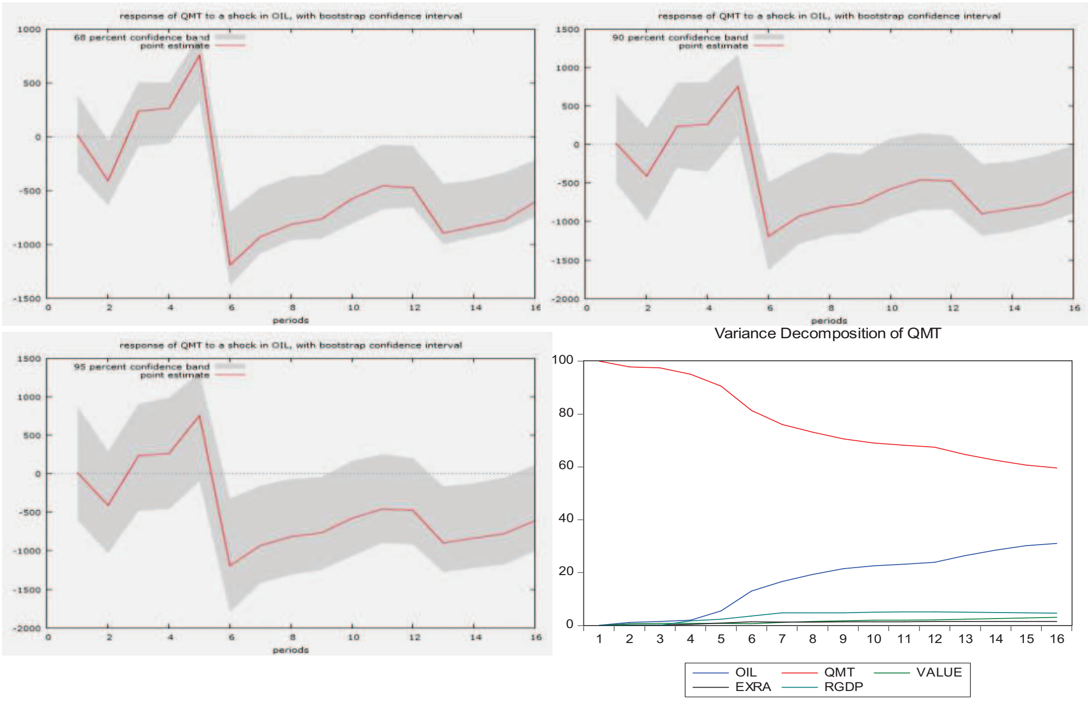

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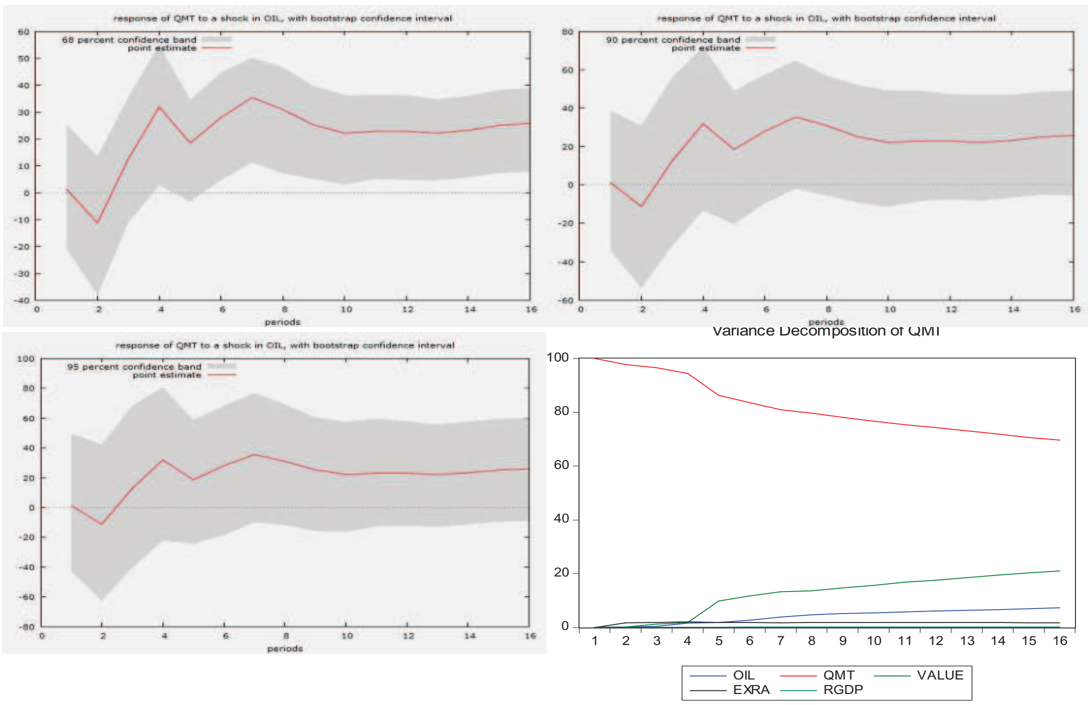

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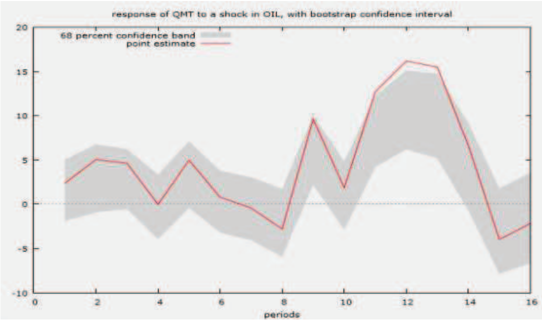
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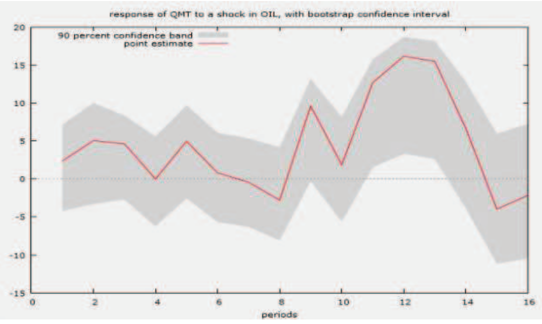
68 percent confidence band
point estimate
periods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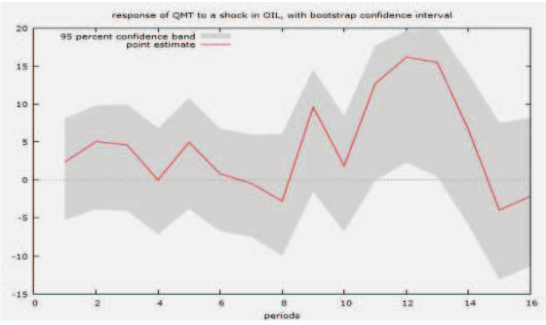
90 percent confidence band
point estimate
periods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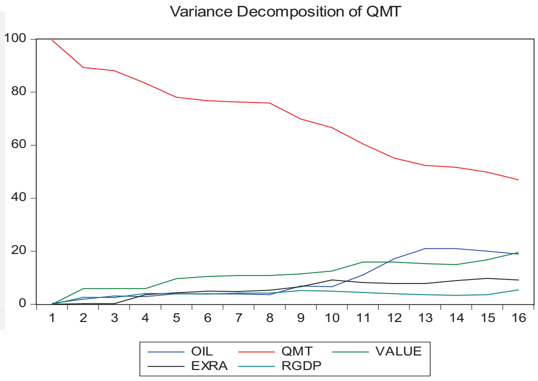
95 percent confidence band
point estimate
periods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RGDP

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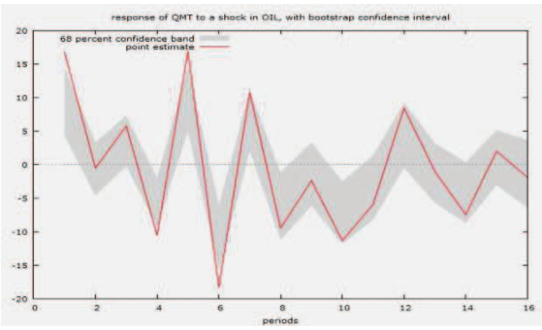
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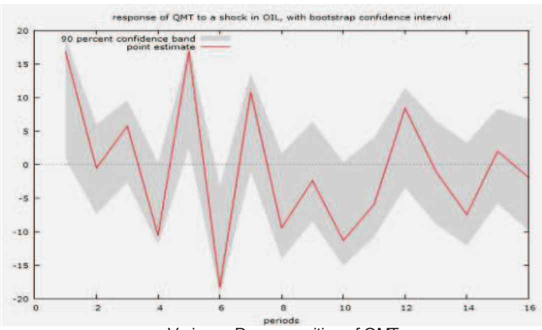
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point estimate
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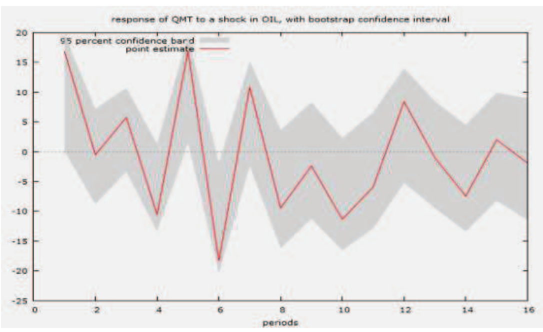
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point estimate
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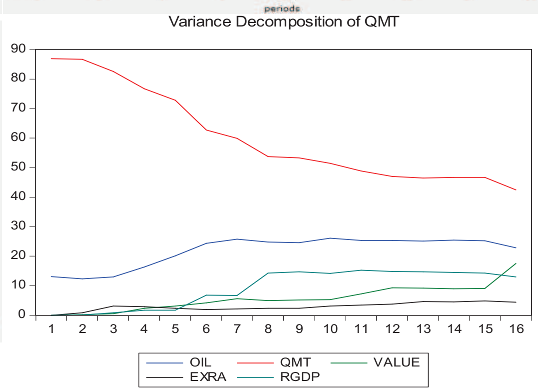
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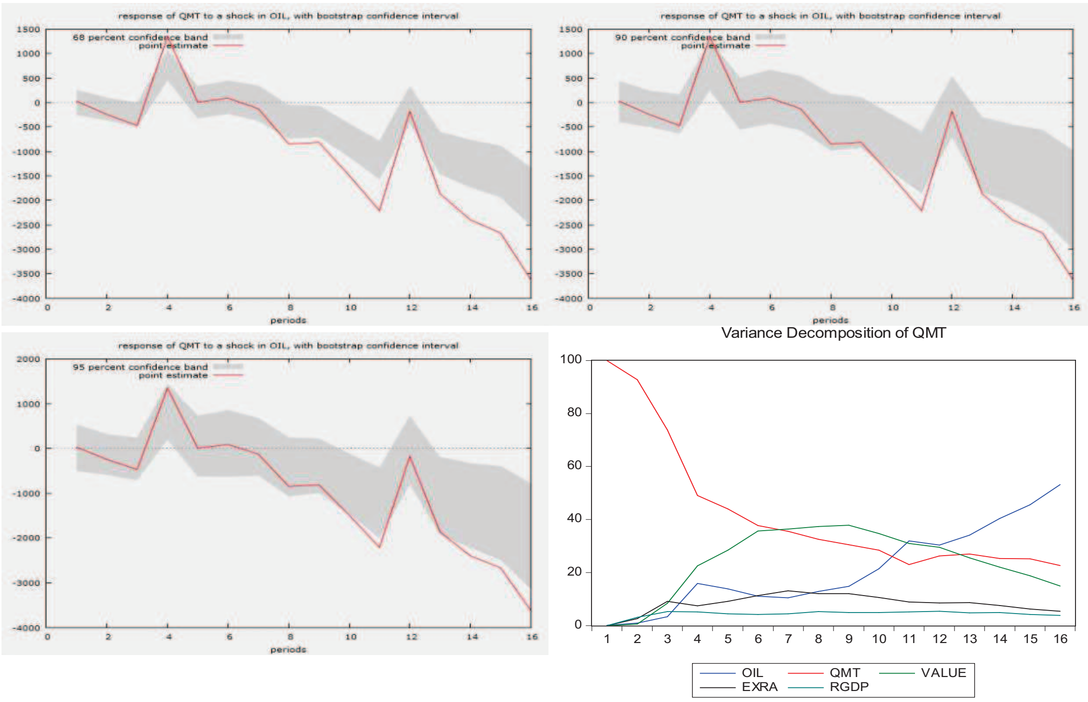
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Variance Decomposition of QMT
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RGDP

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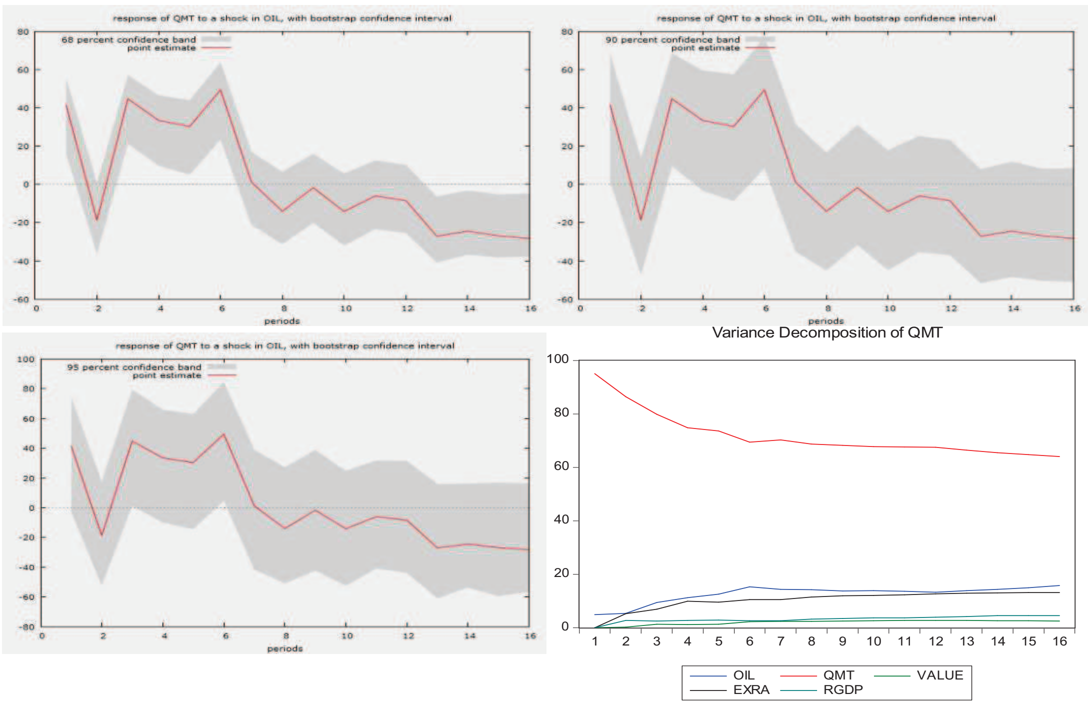
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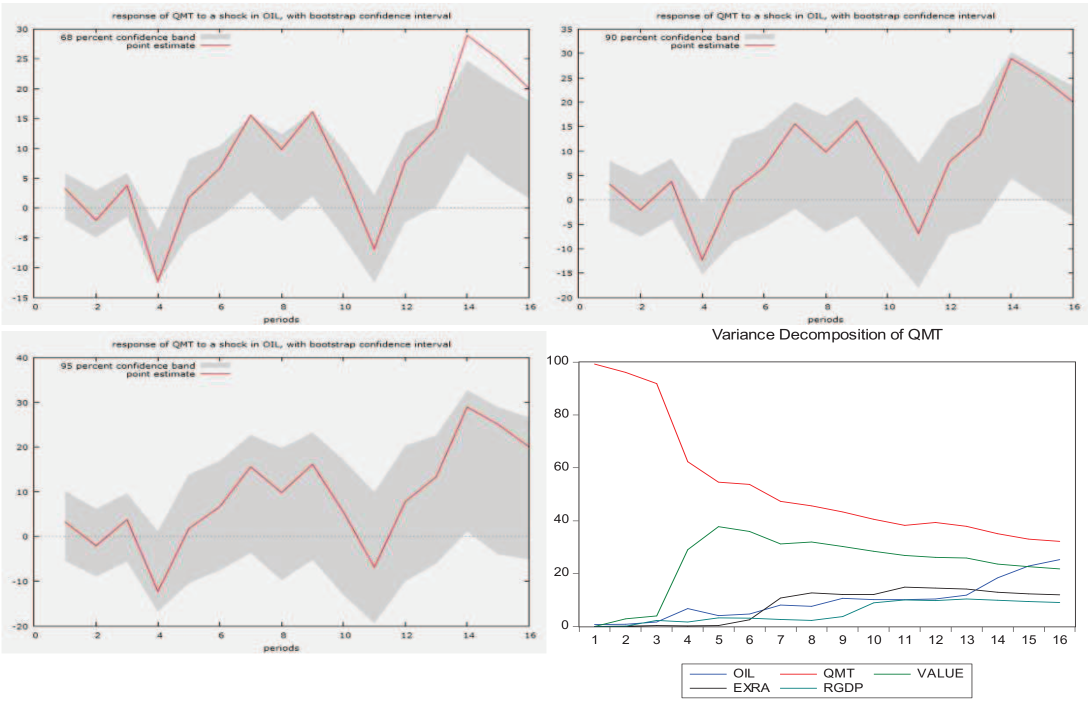
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RGDP

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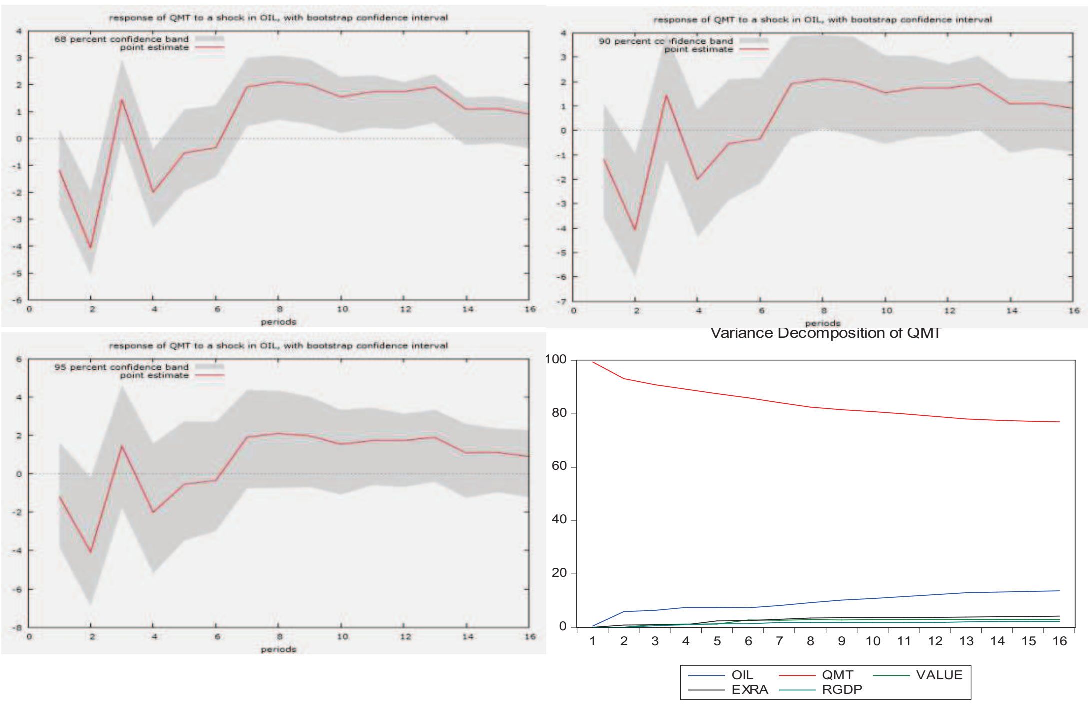
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point estimate
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RGDP

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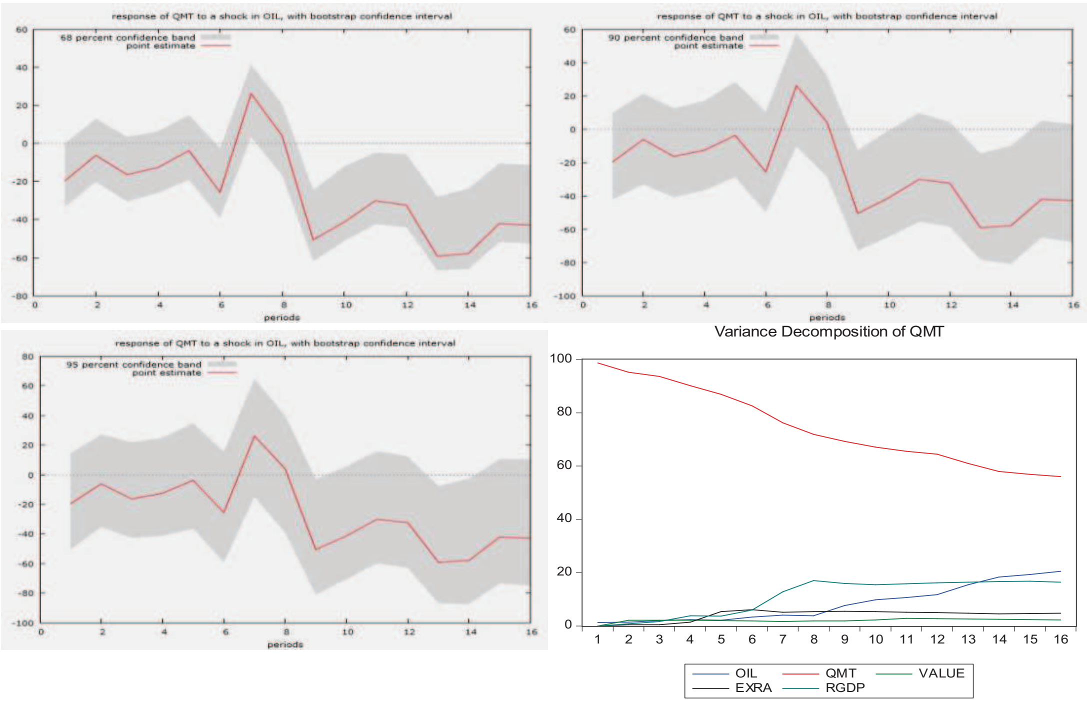
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OIL
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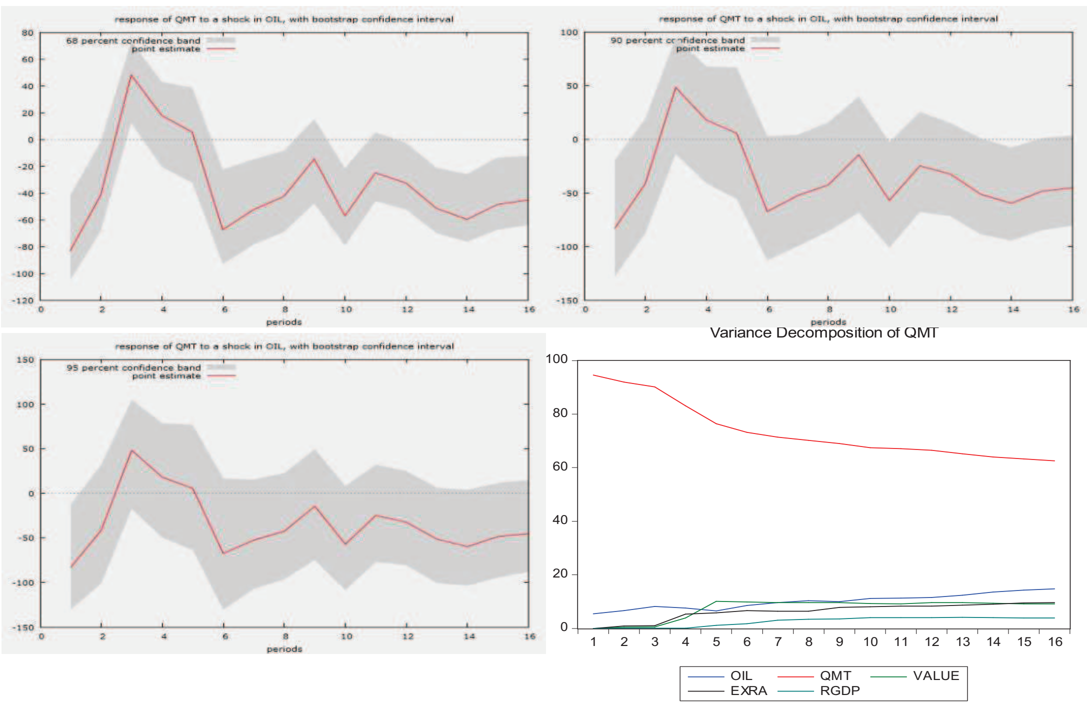
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RGDP

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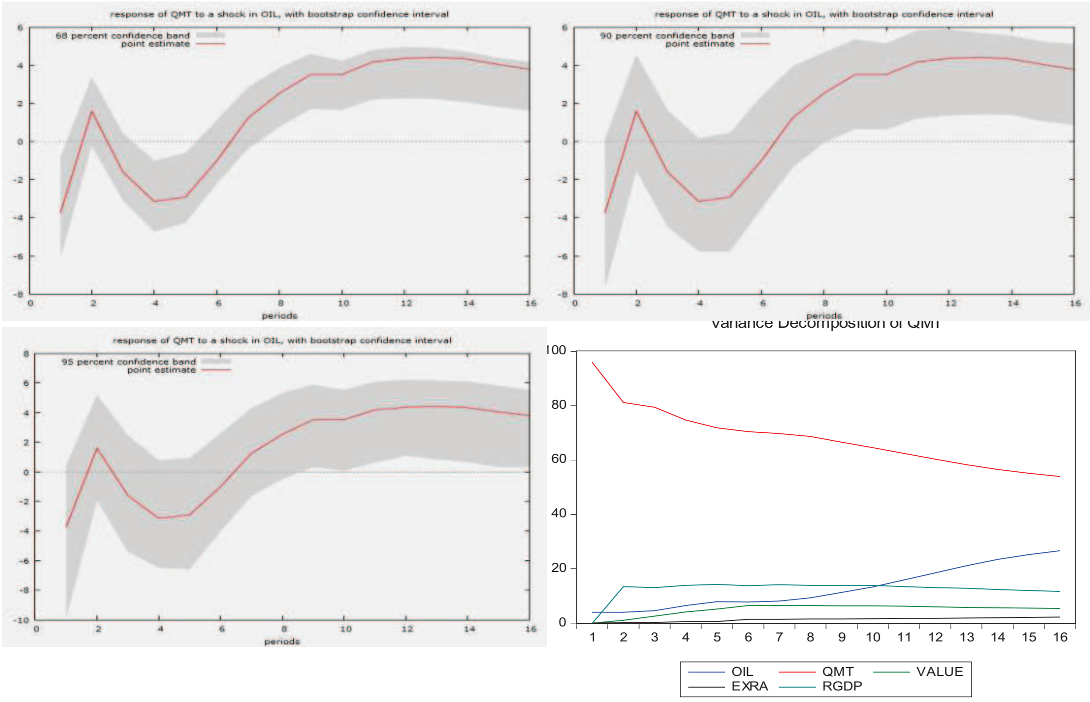
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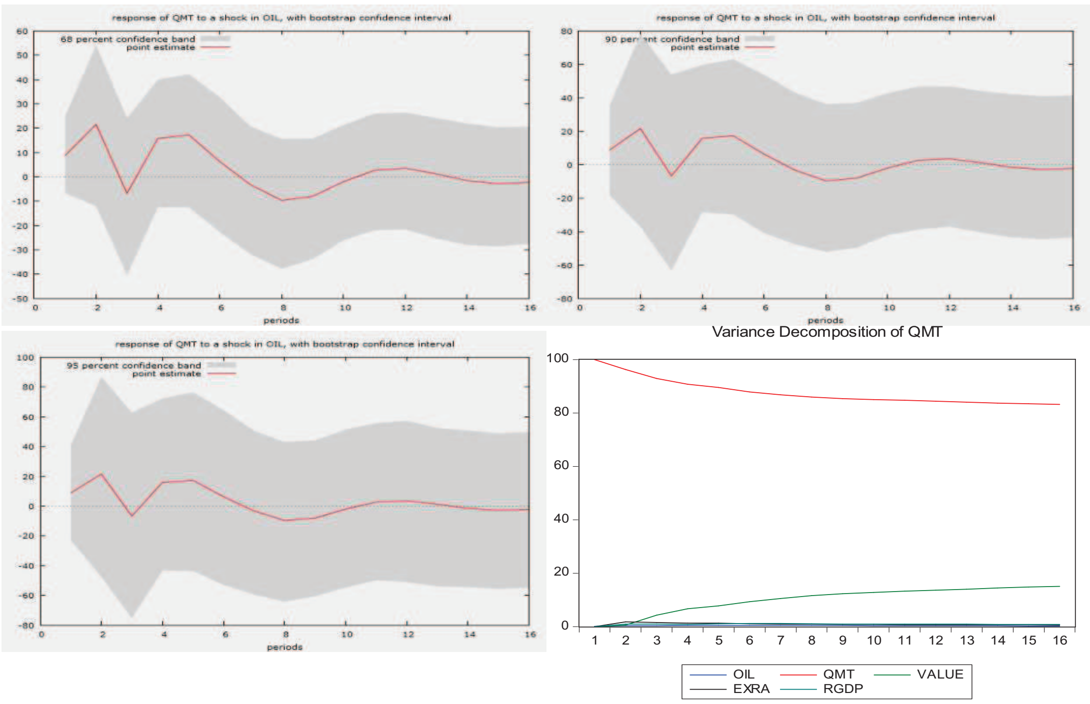
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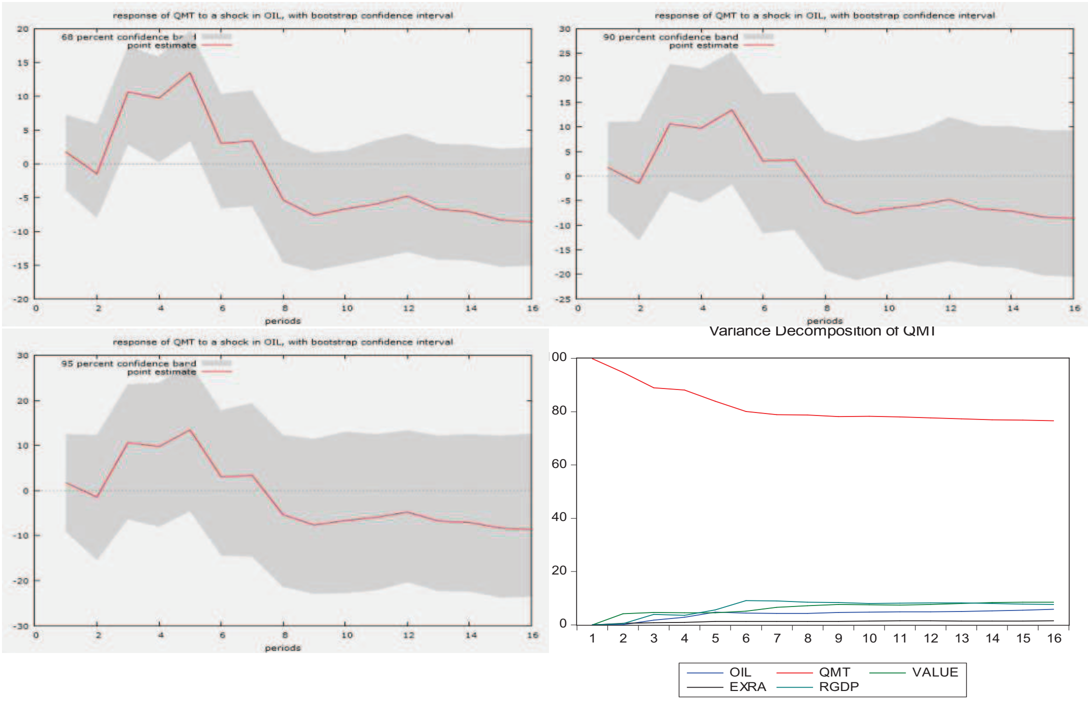
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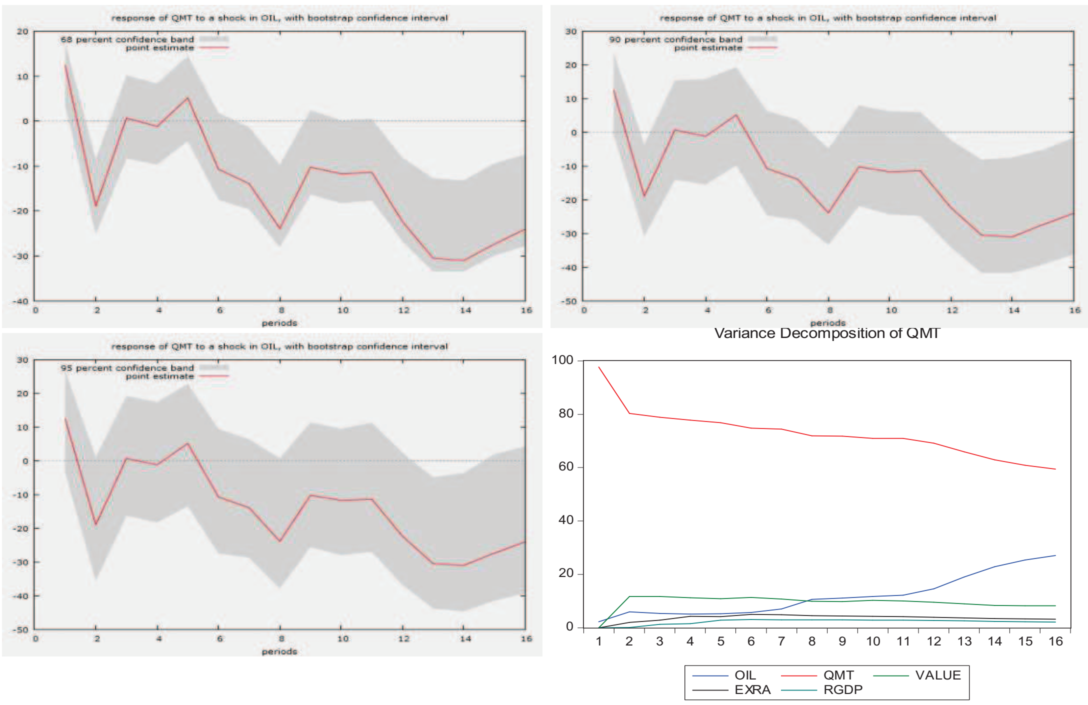
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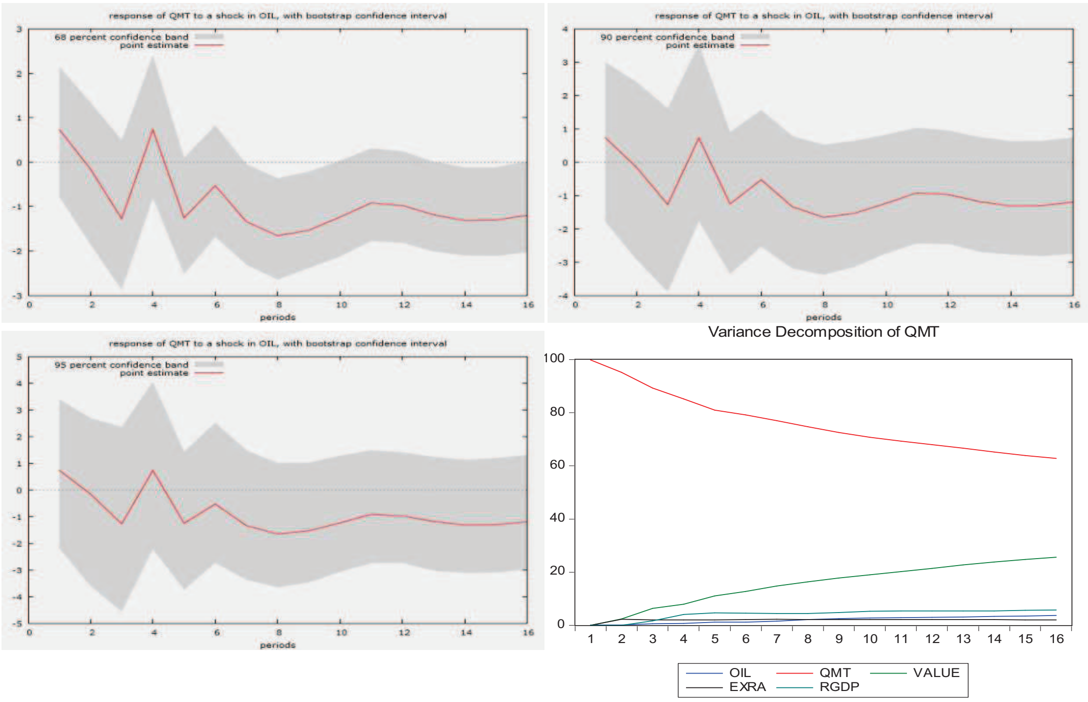
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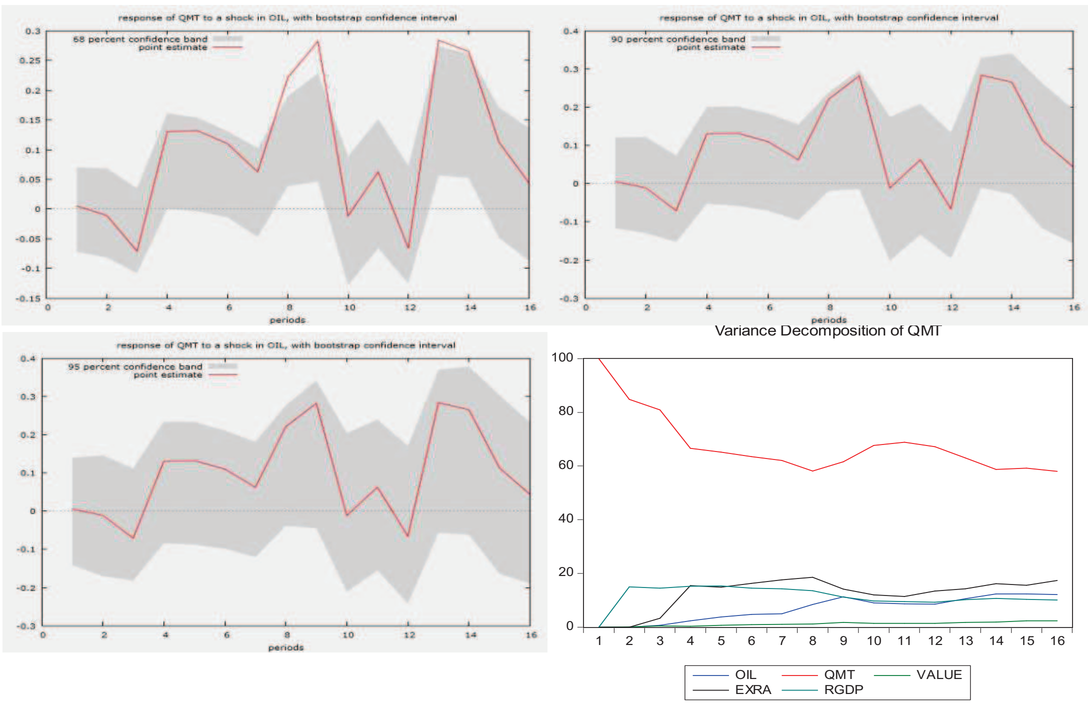
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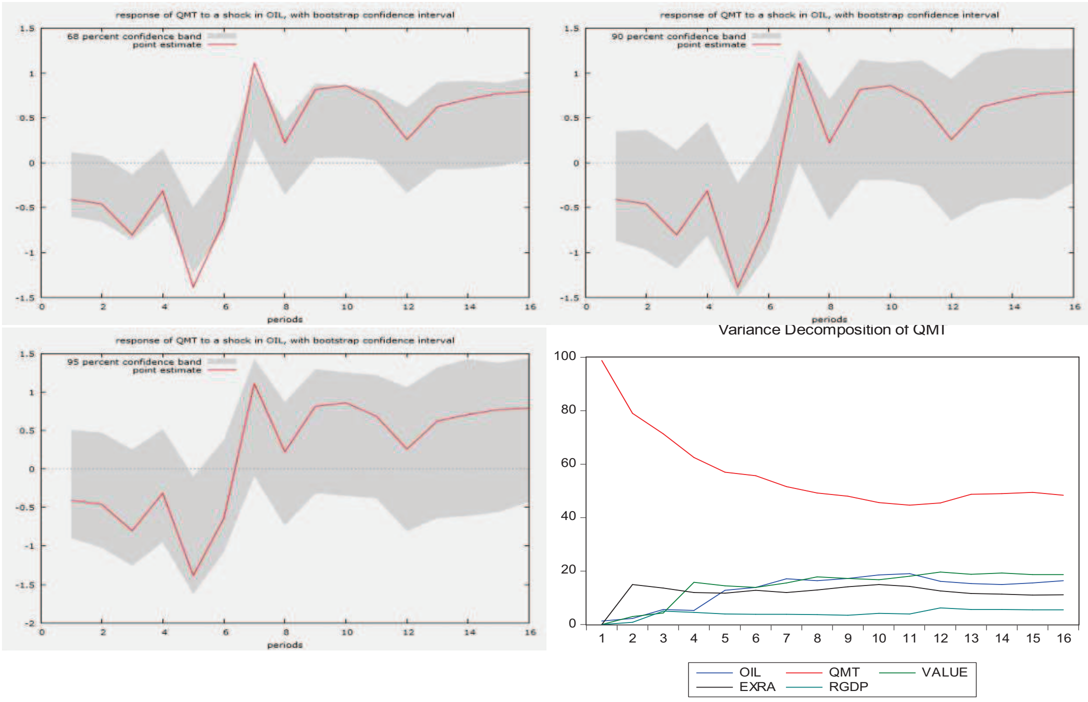
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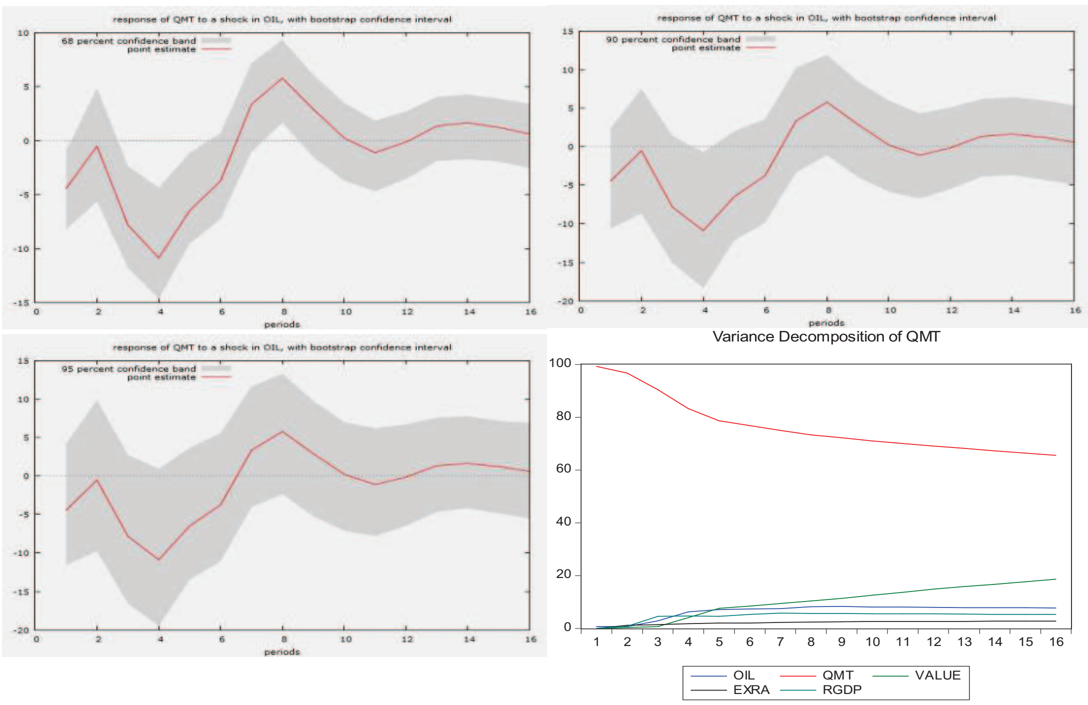
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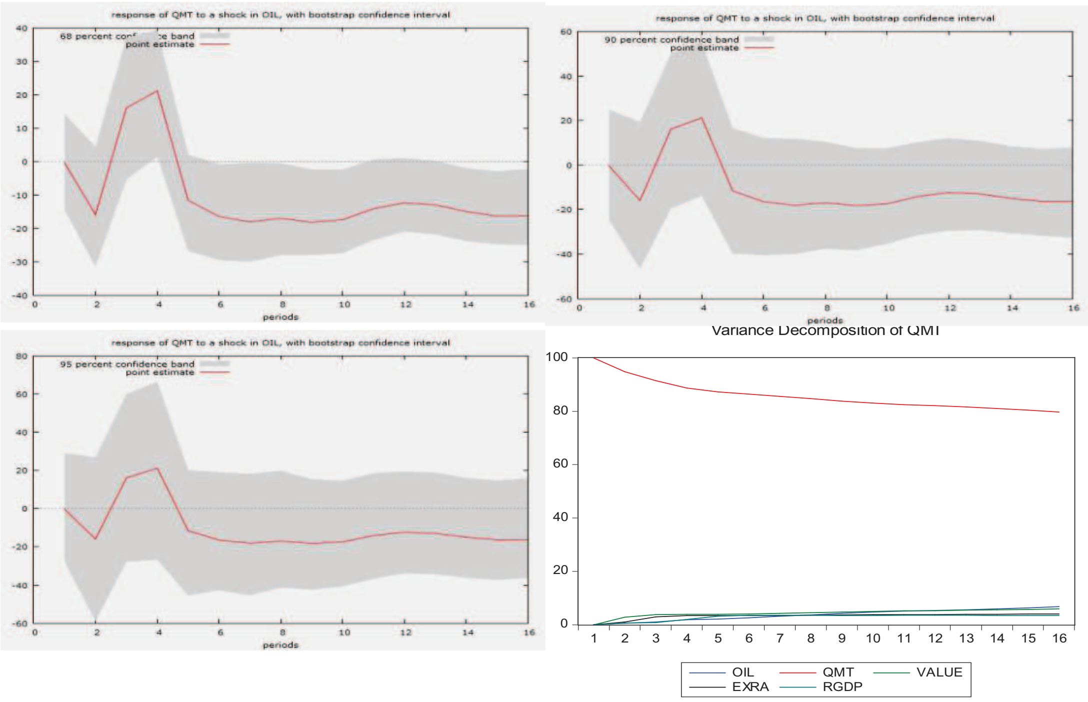
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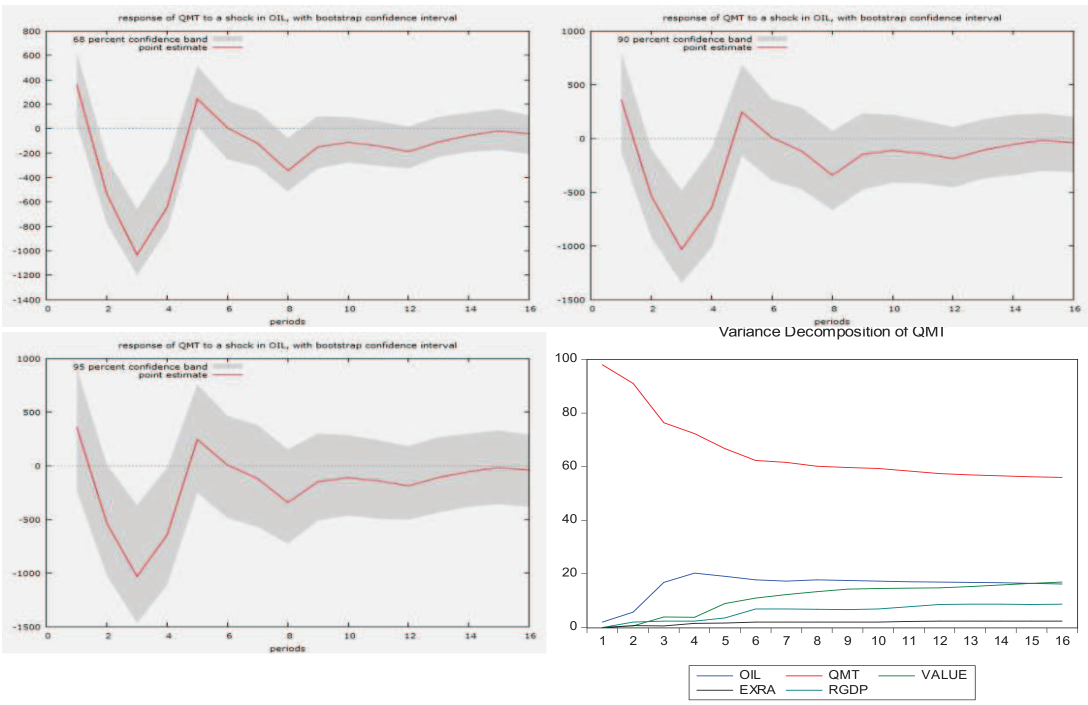
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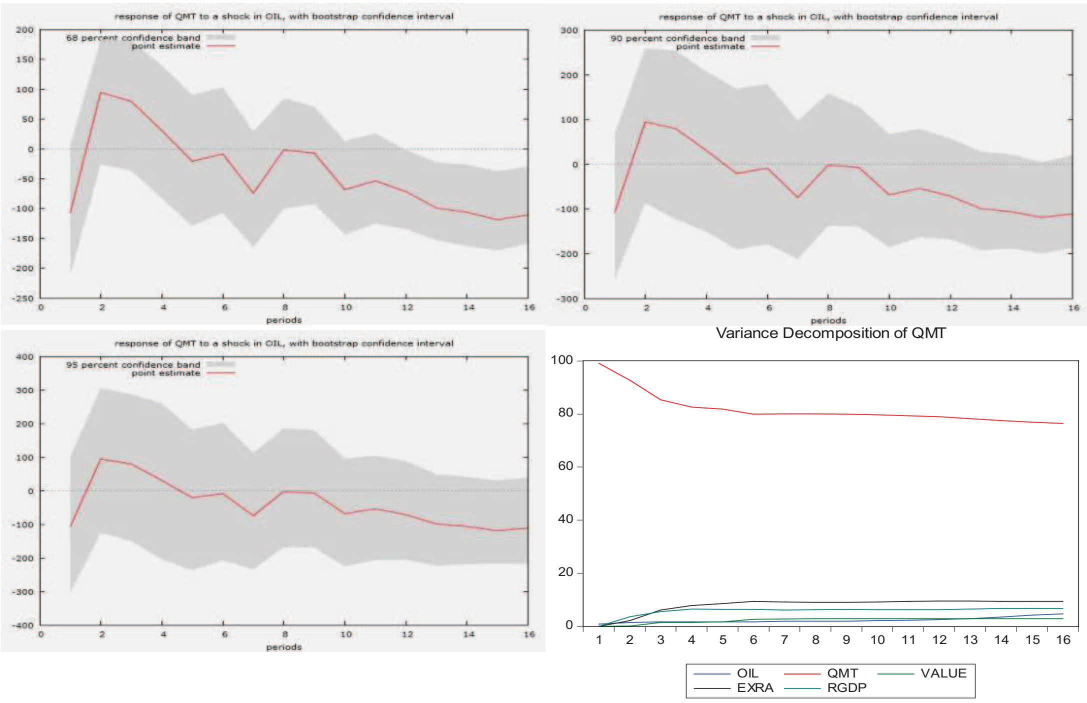
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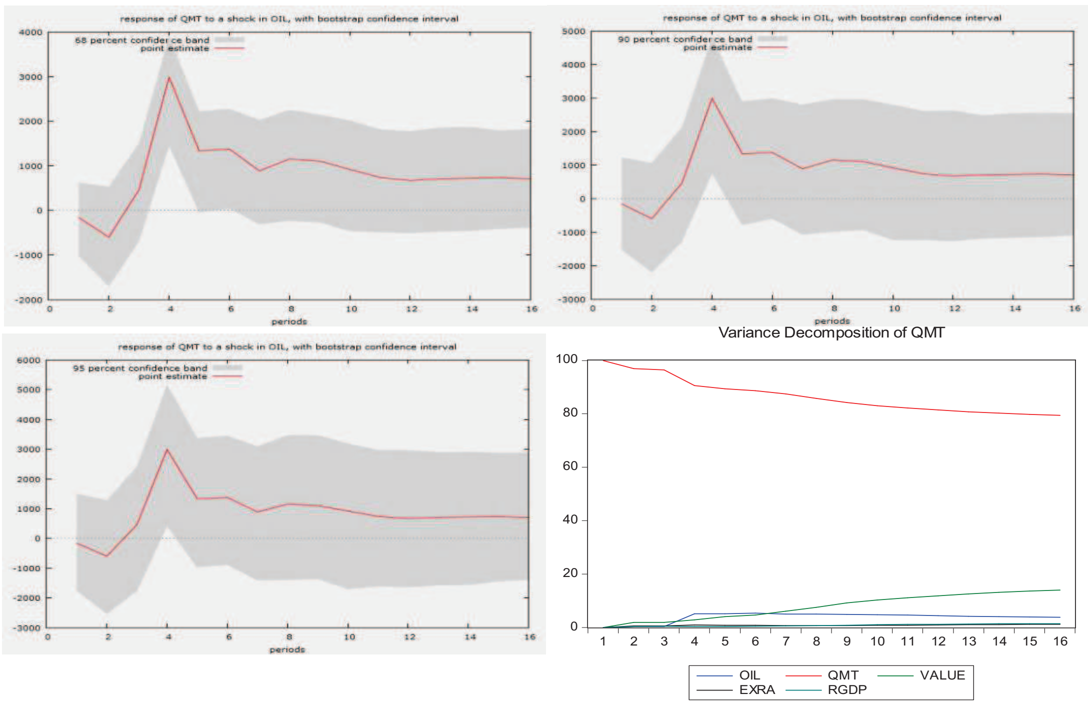
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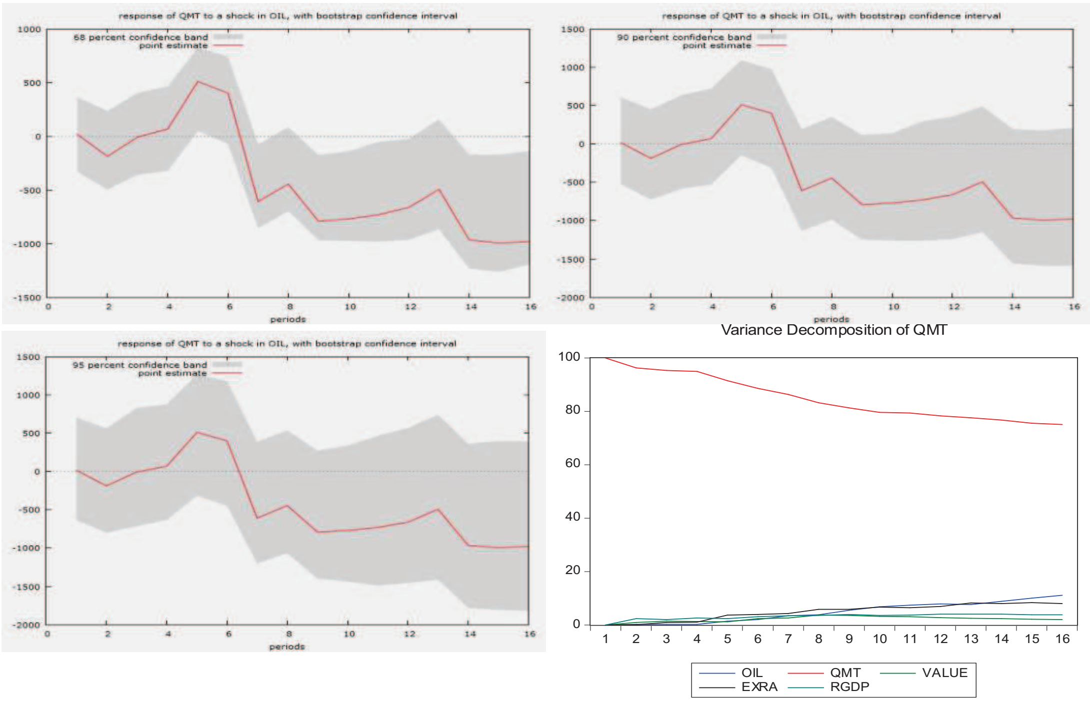
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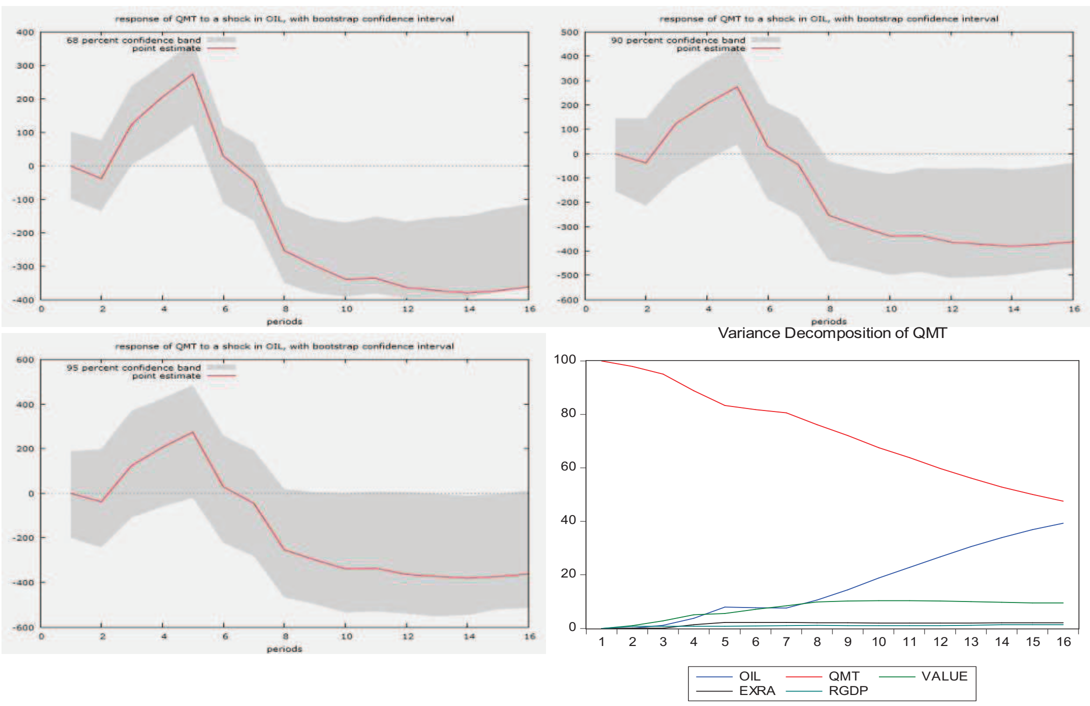
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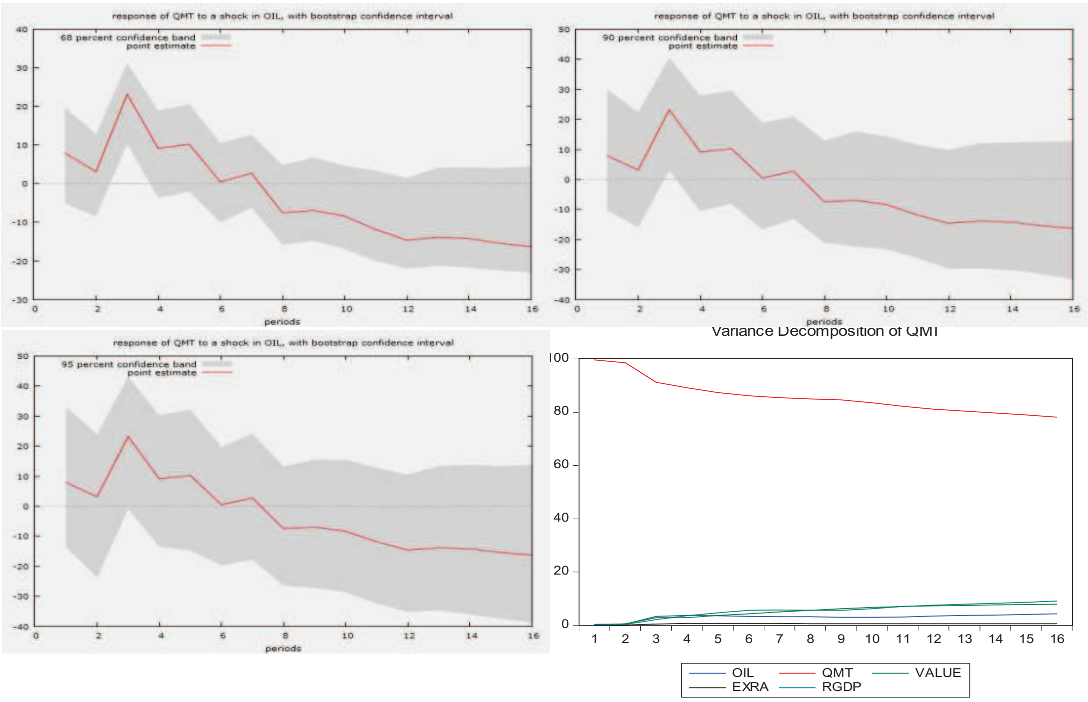
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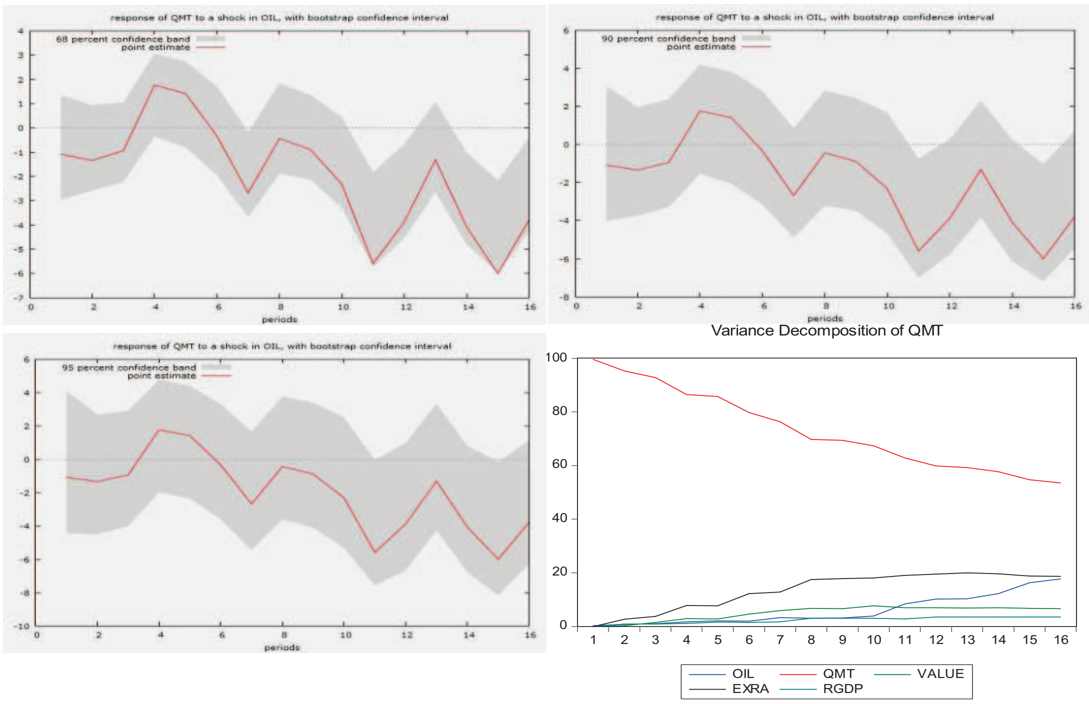
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4.2.1.6 Spain

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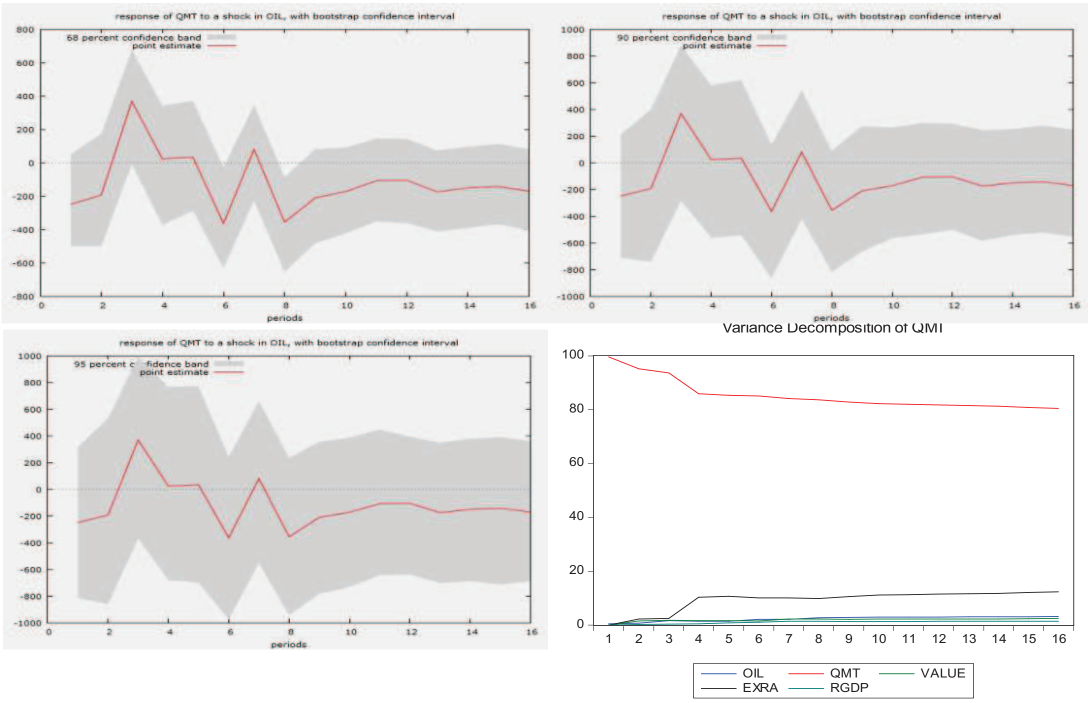

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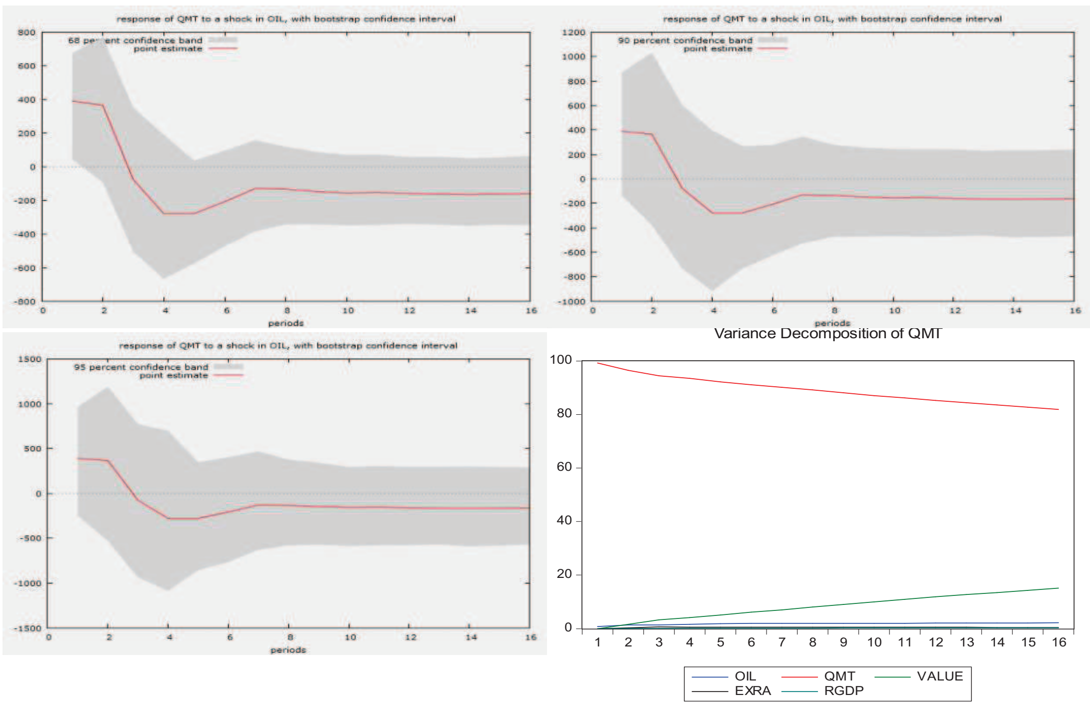

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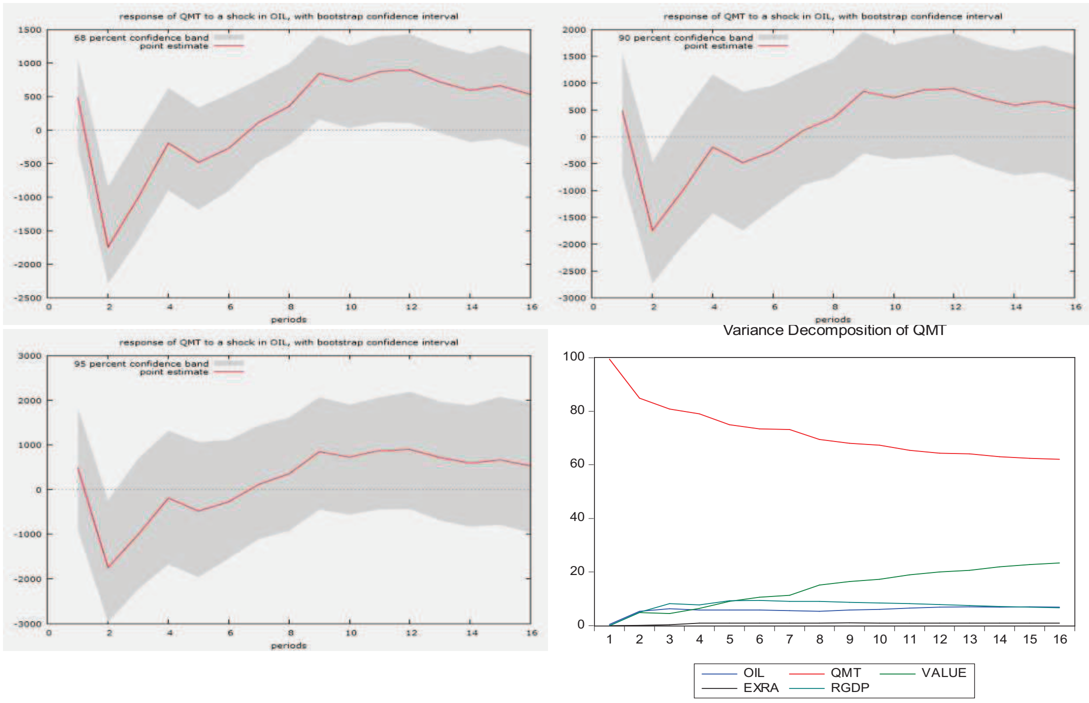
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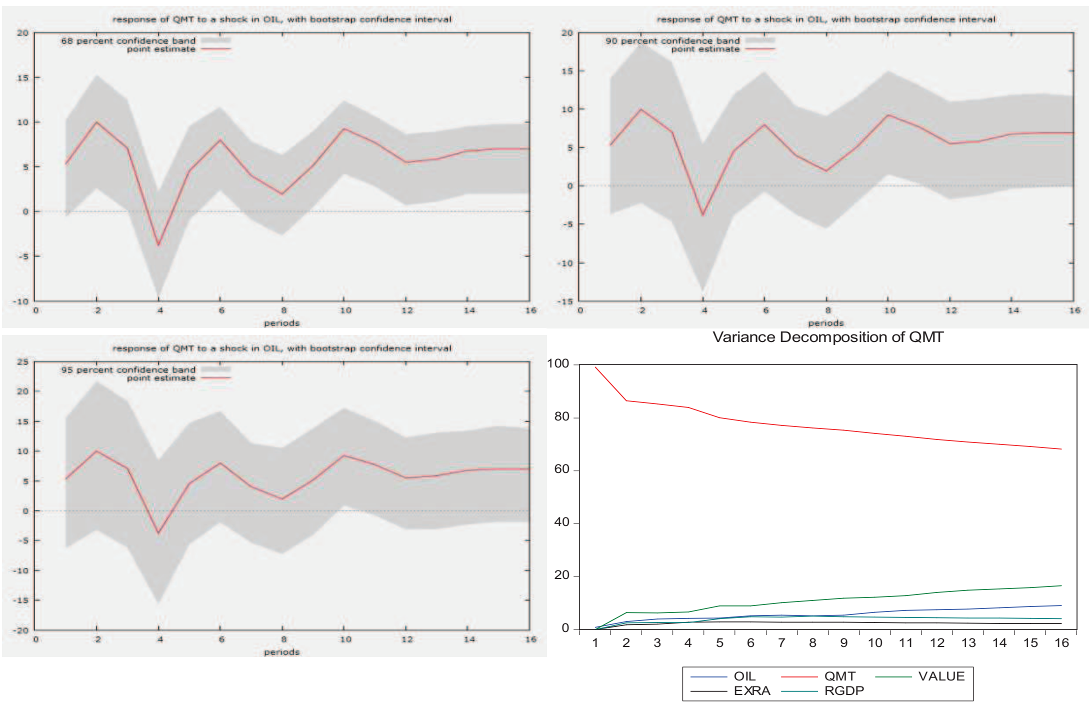
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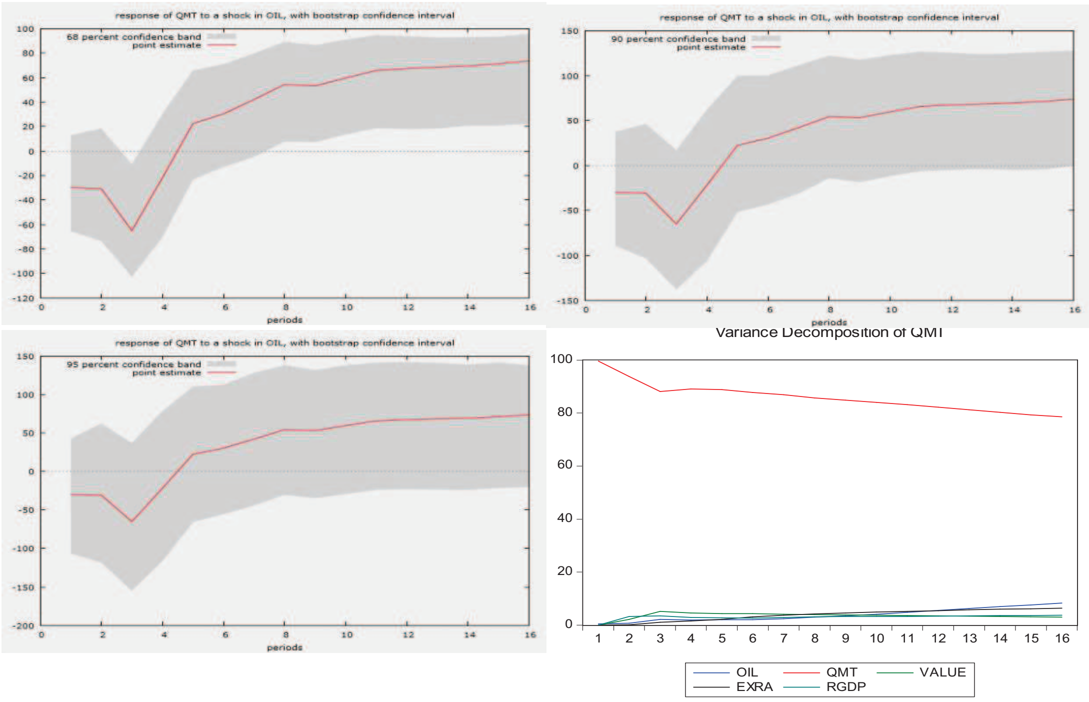
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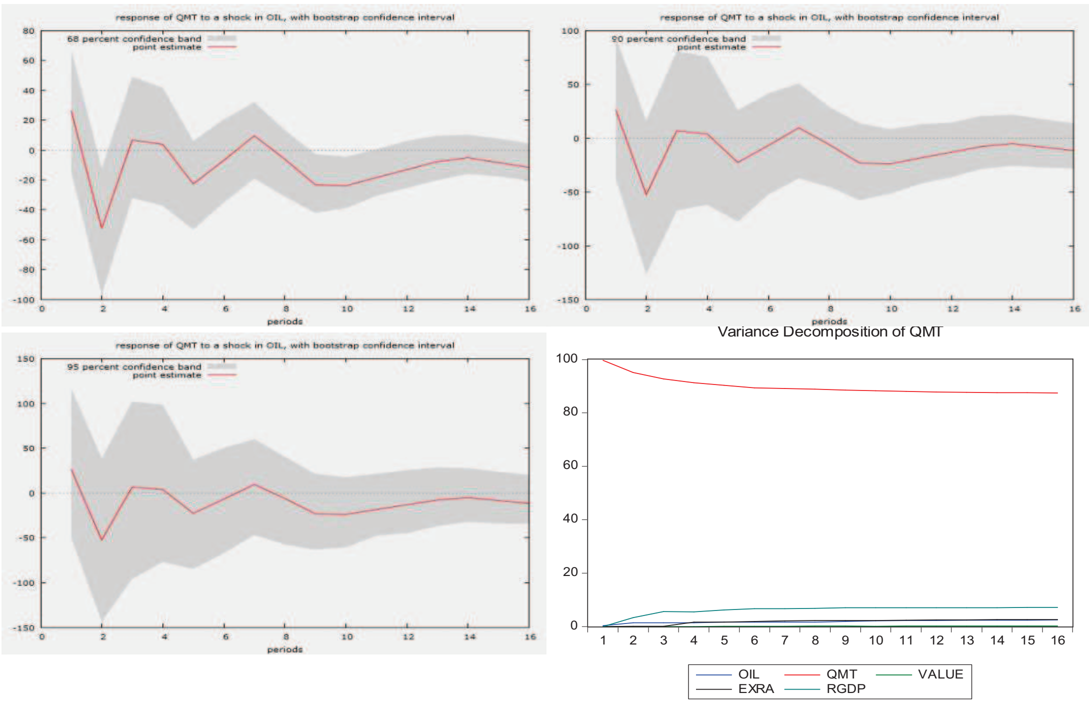
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RGDP

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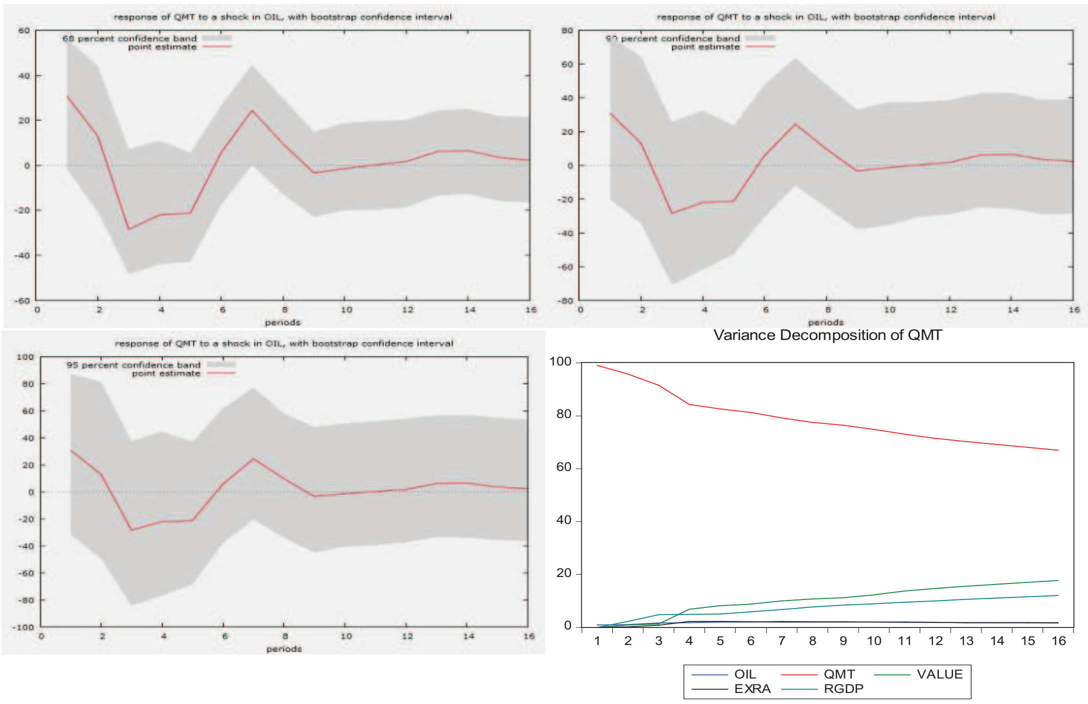
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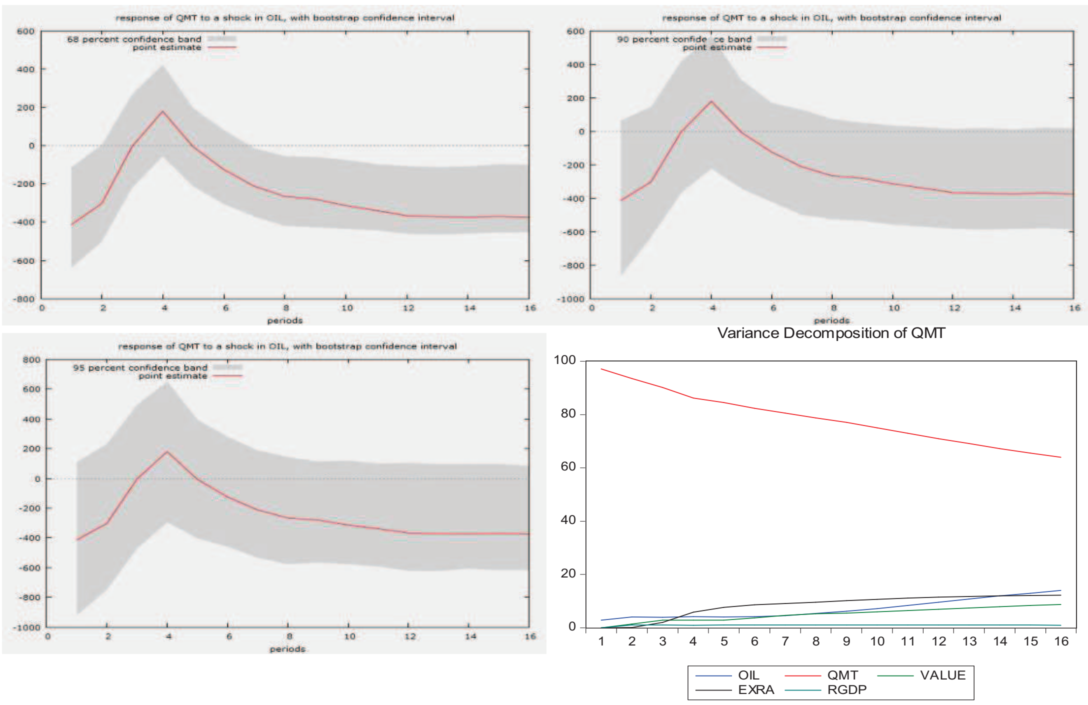
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90 percent confide ce band
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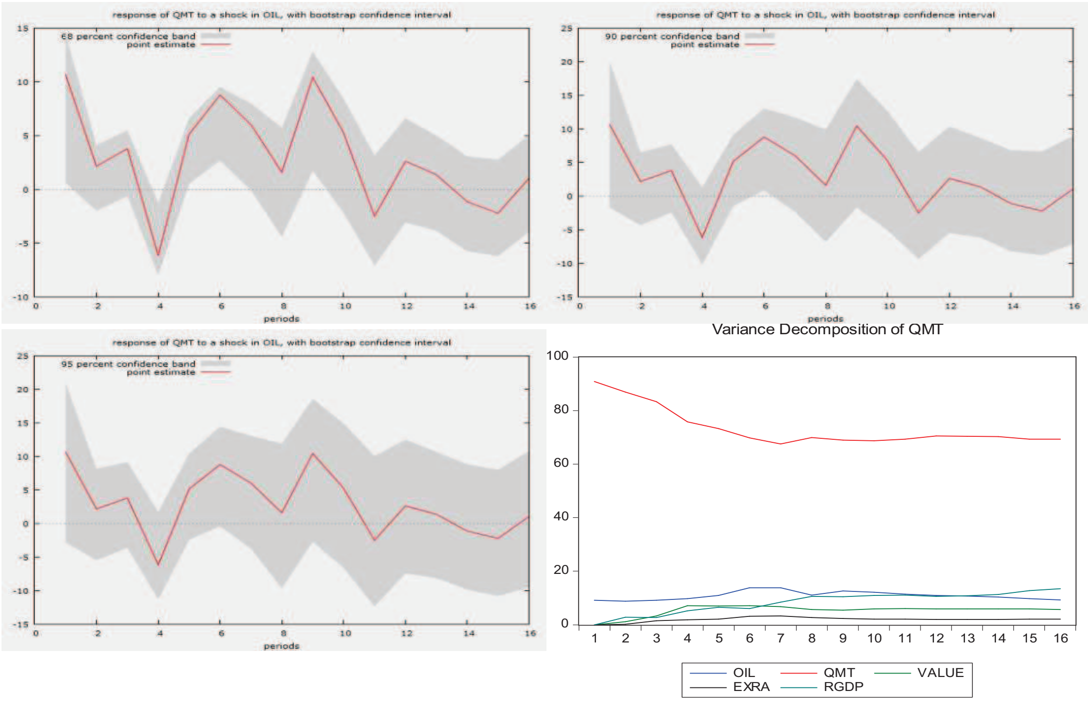
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Variance Decomposition of QMT
OIL
QMT
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RGDP

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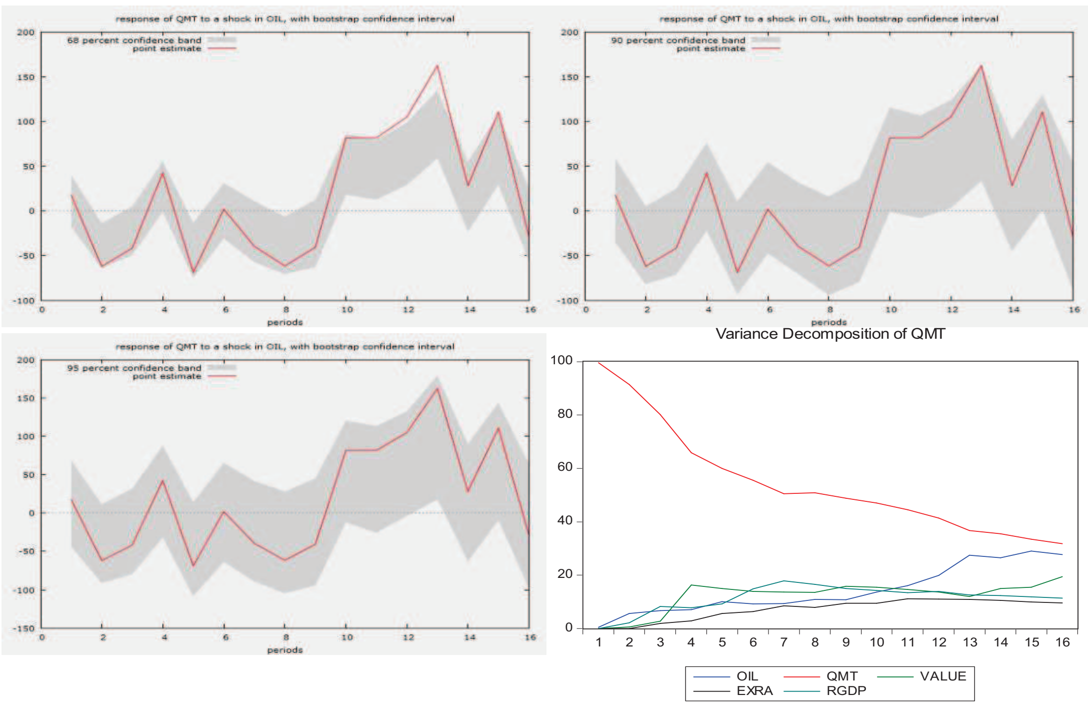
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periods
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OIL
QMT
VALUE
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RGDP

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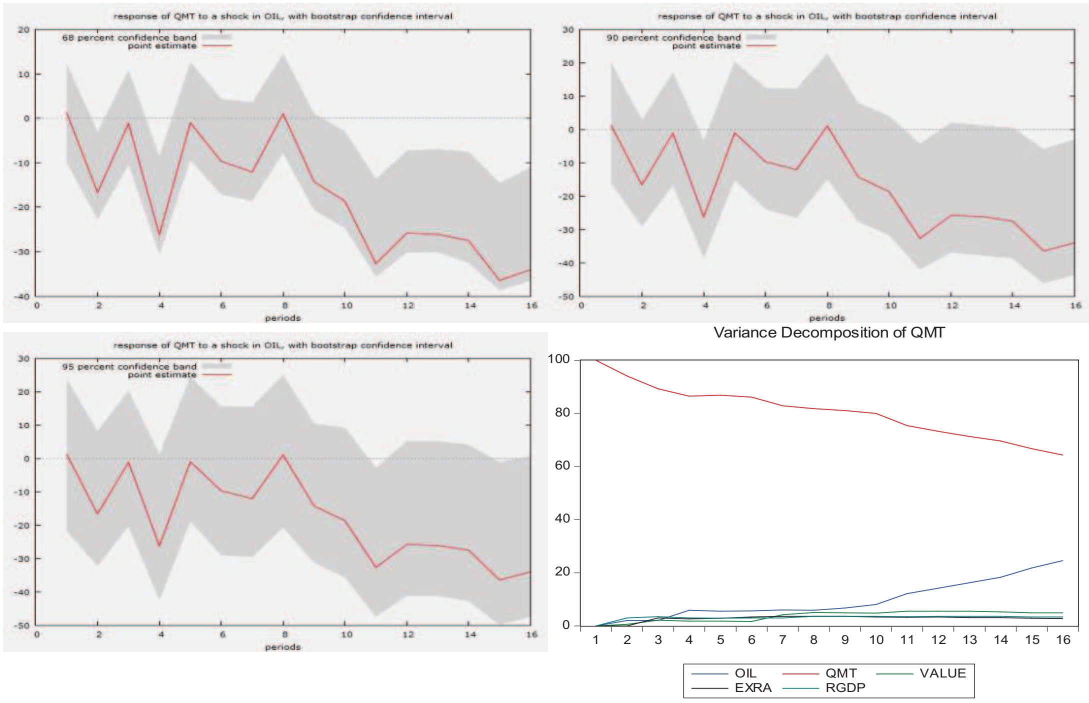
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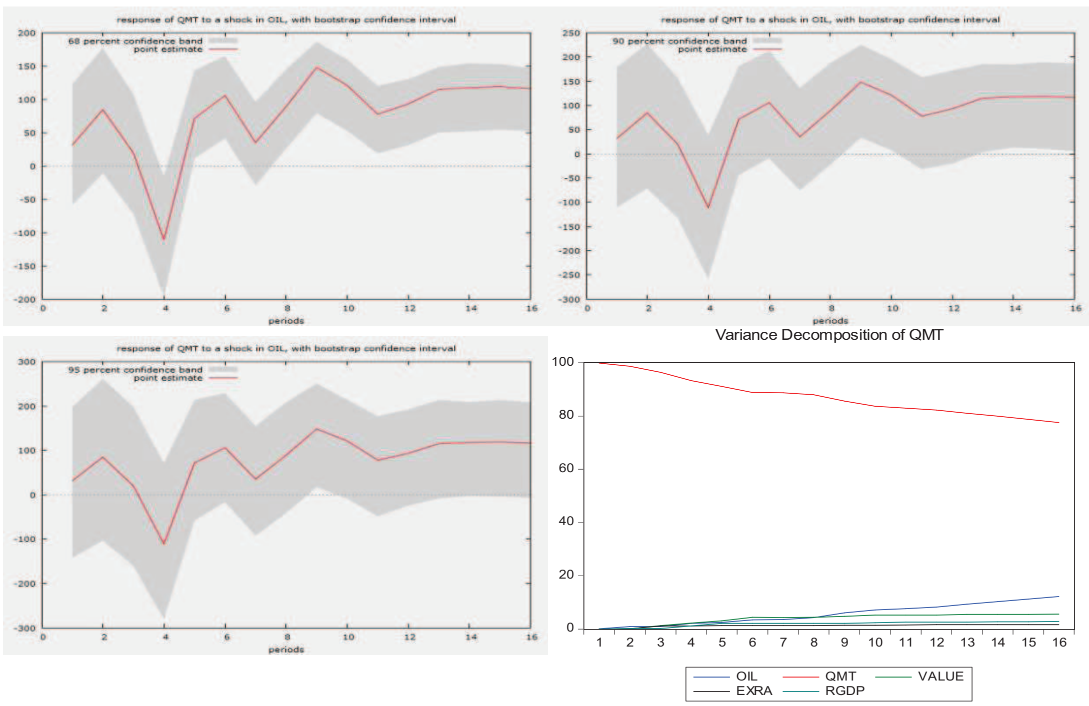
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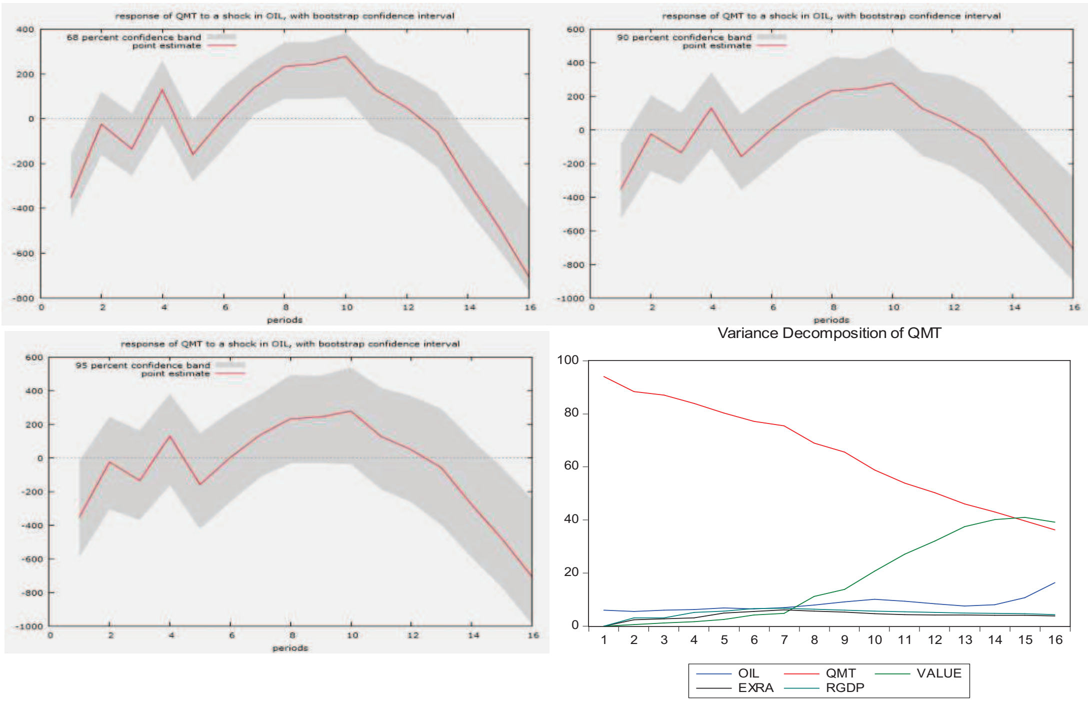
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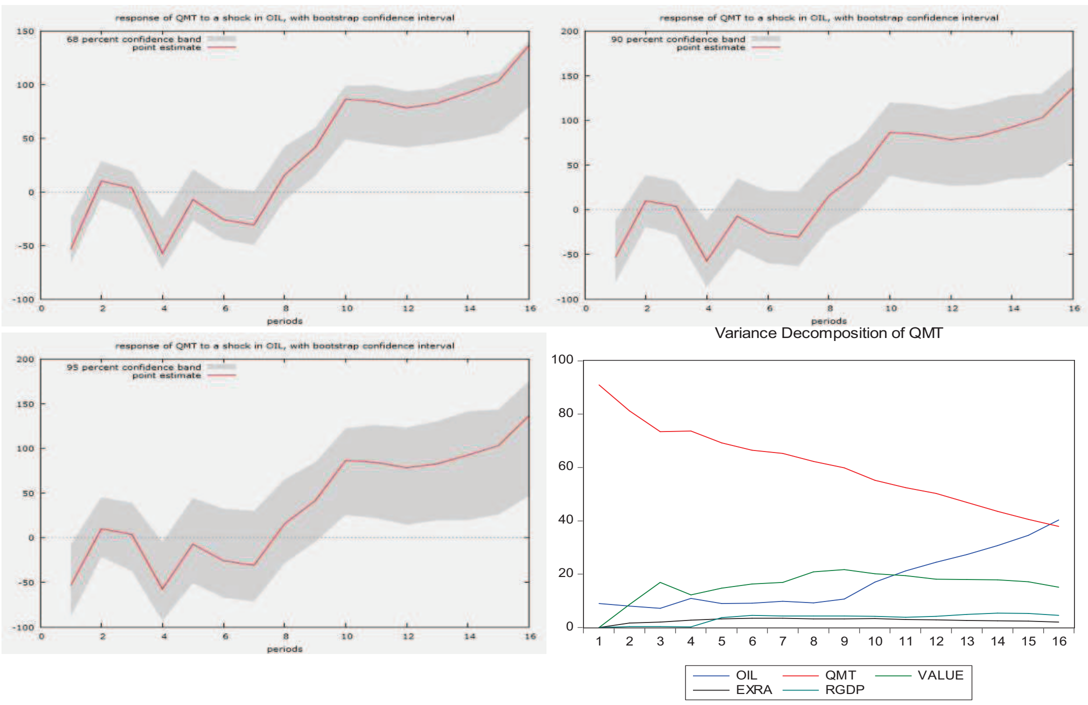
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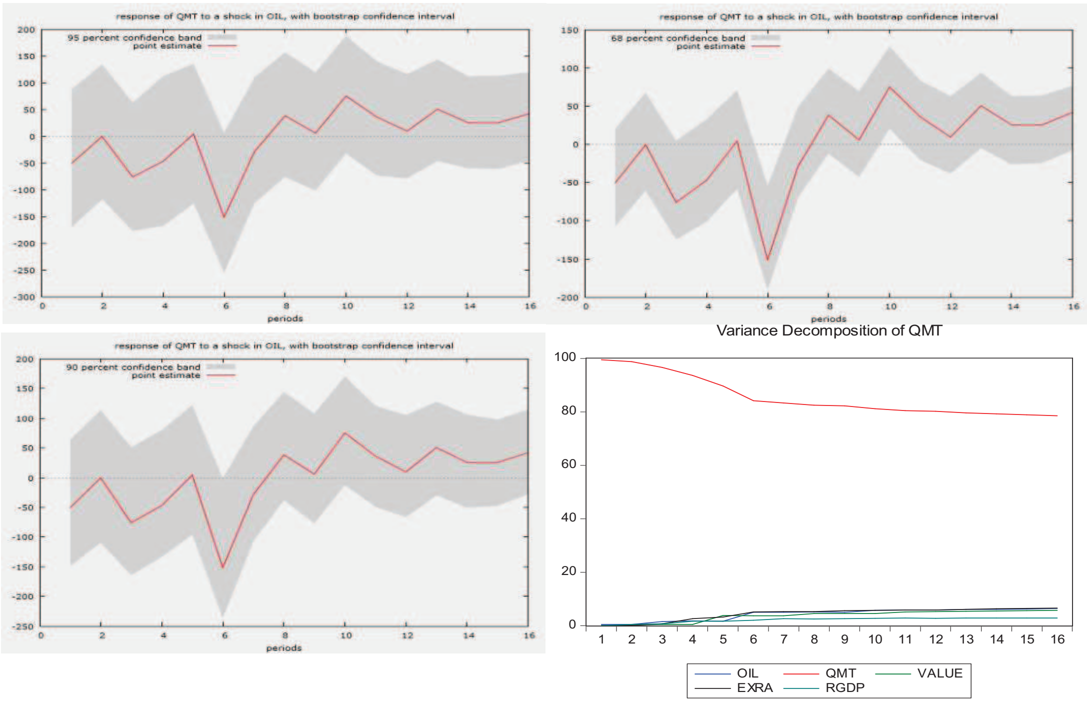
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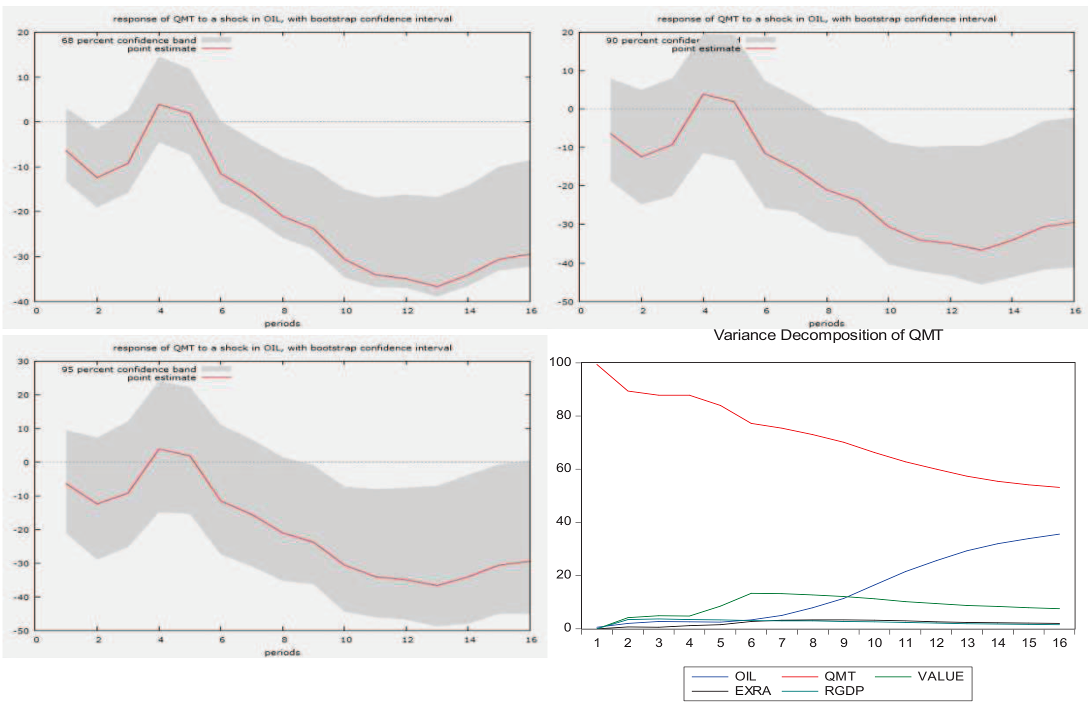
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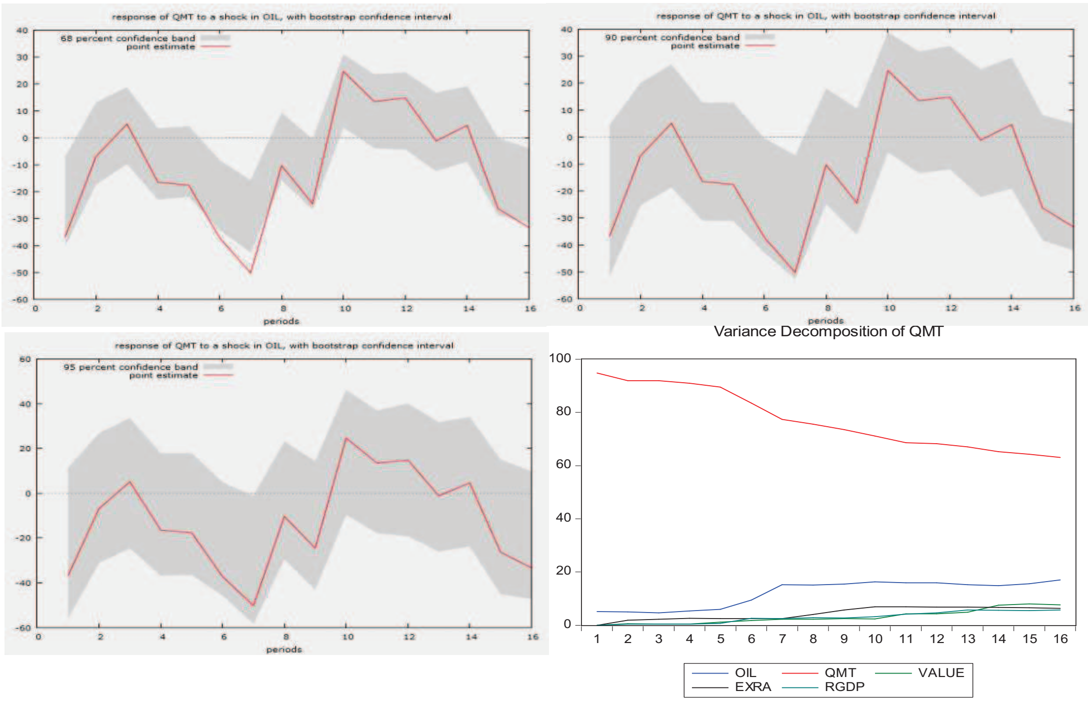
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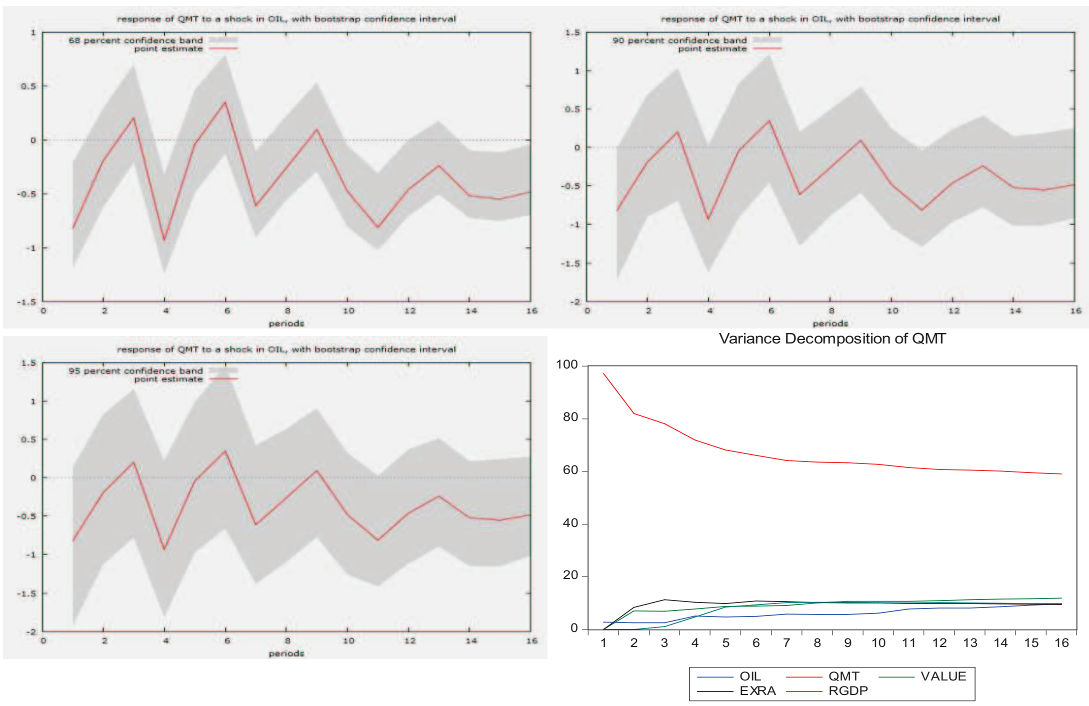
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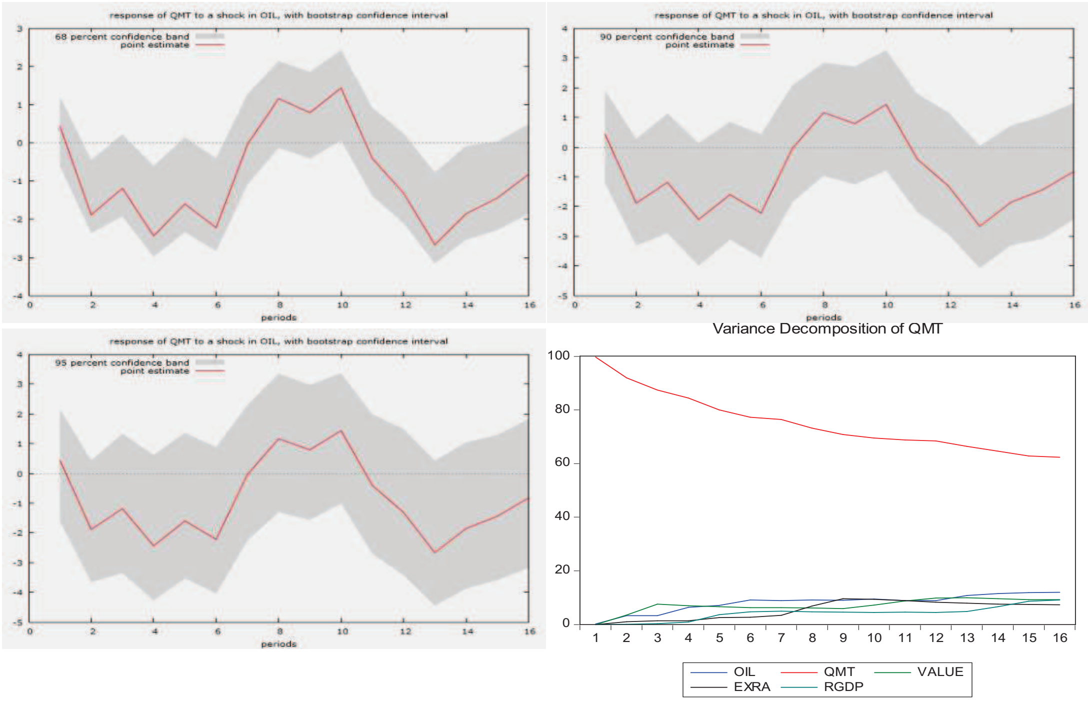
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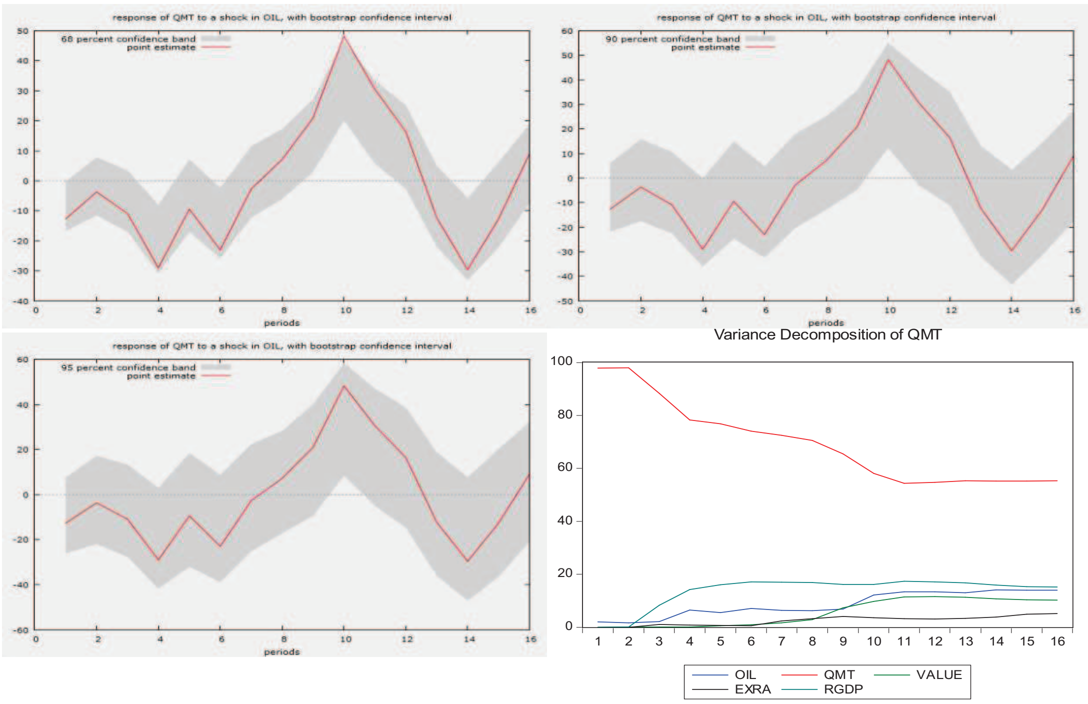
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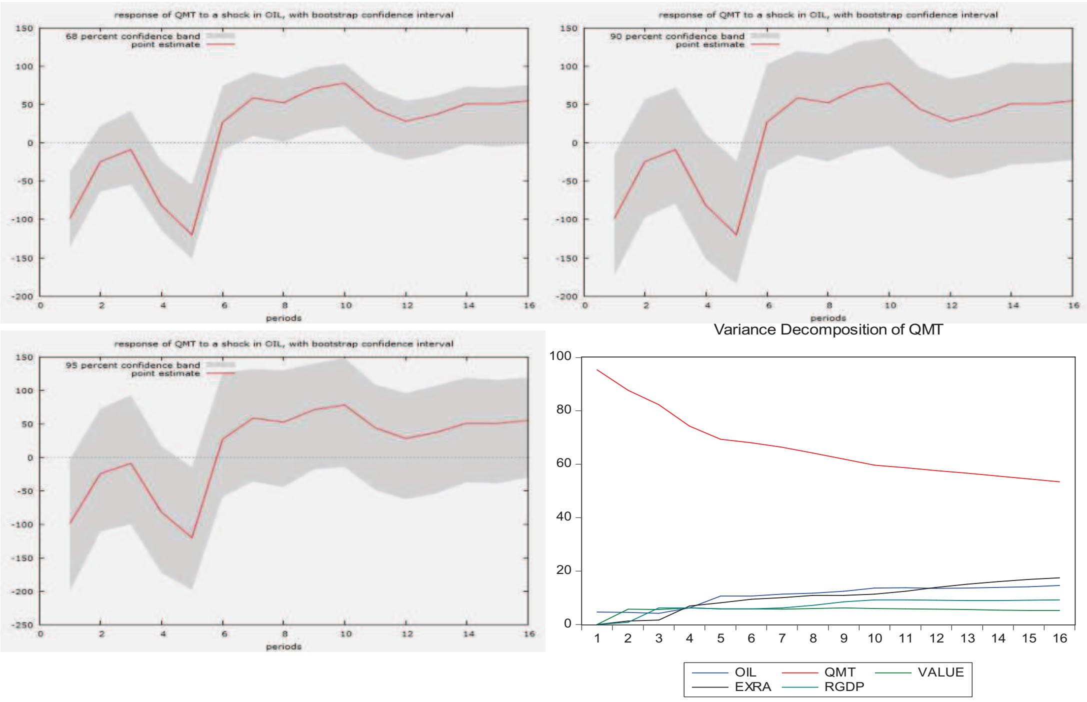
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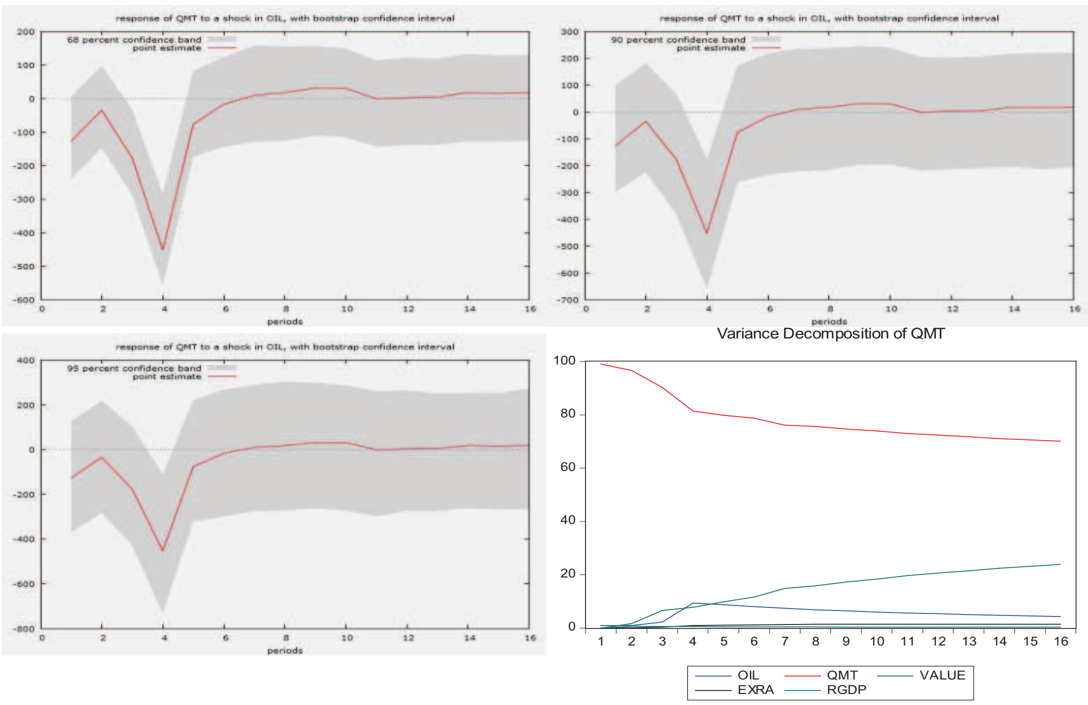
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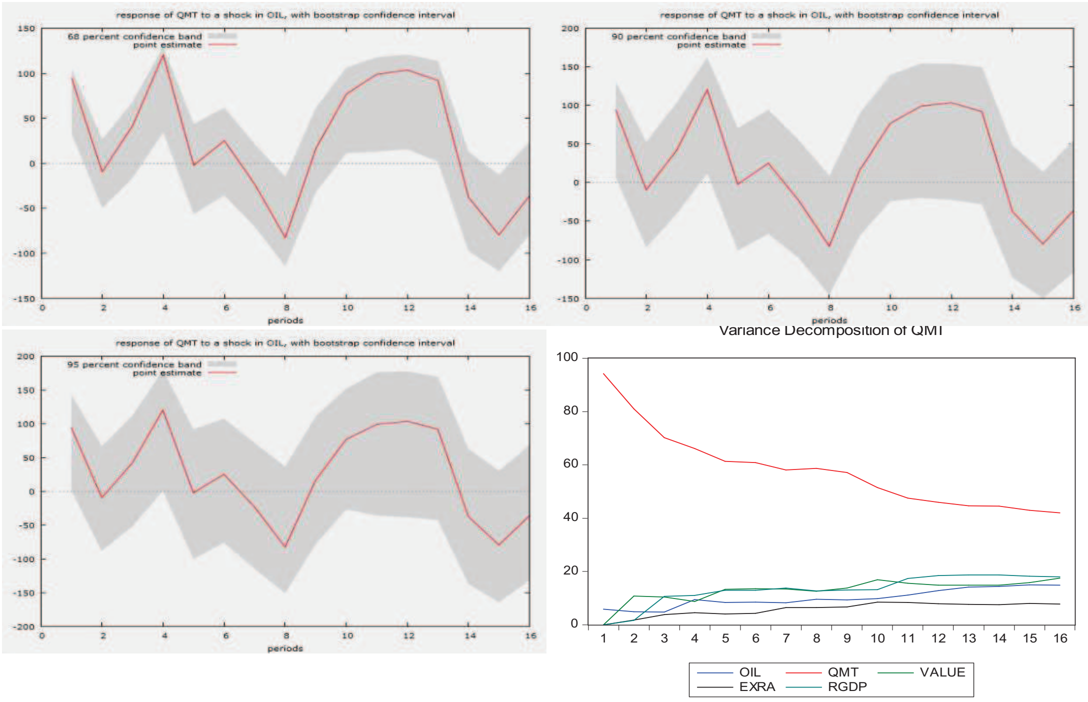
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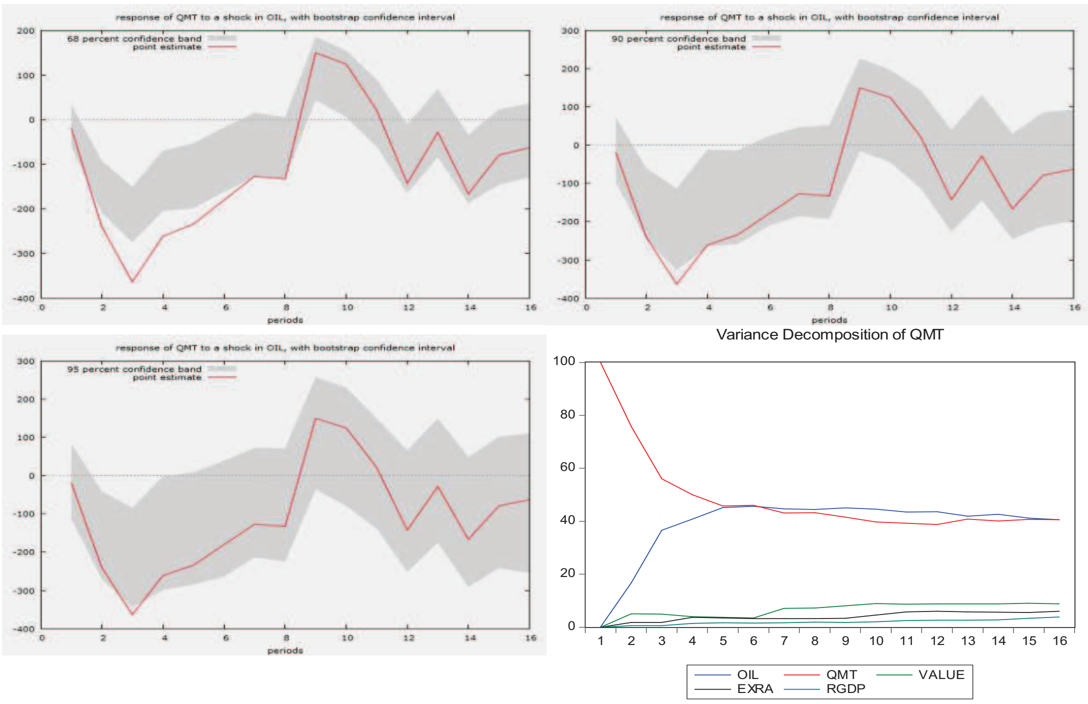
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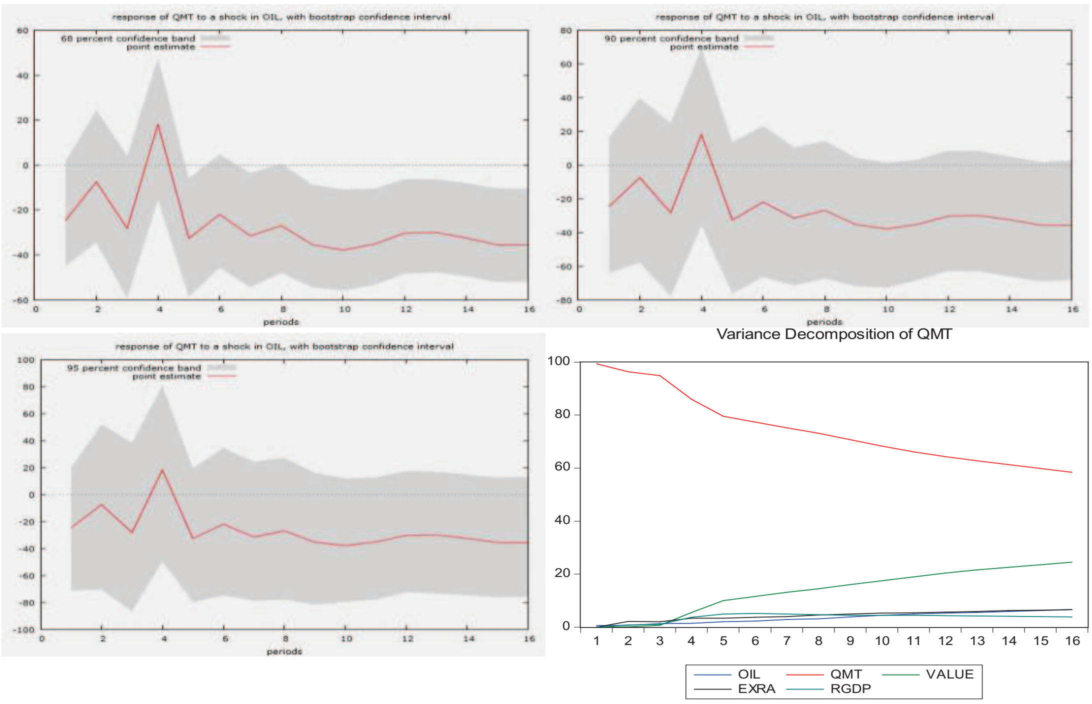
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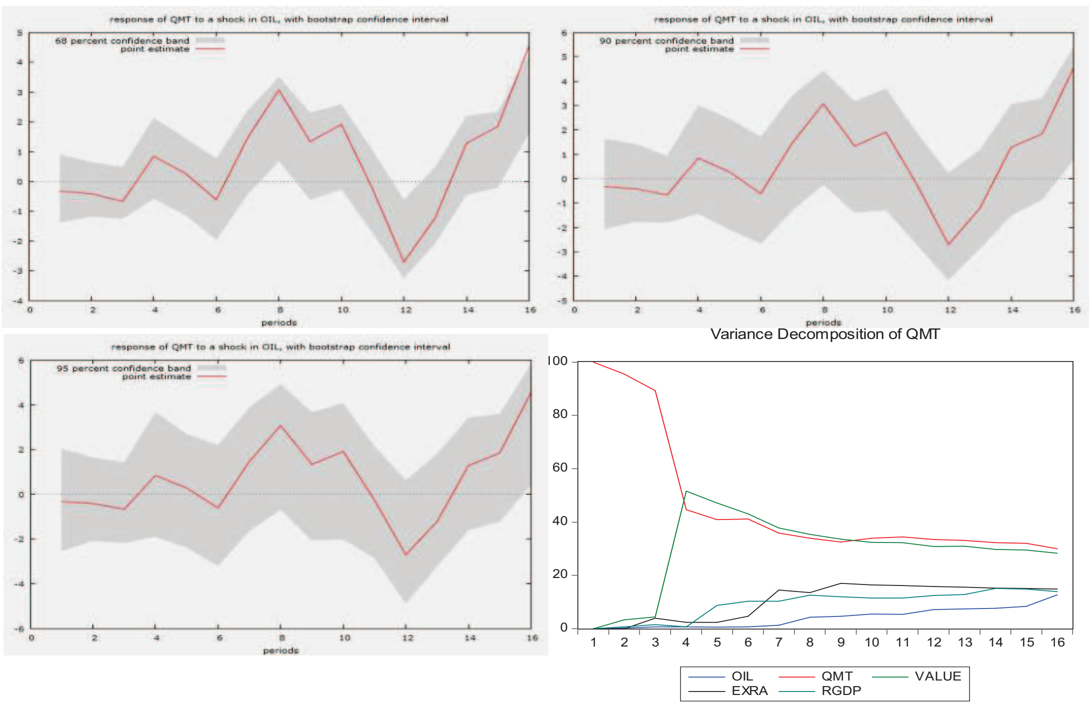
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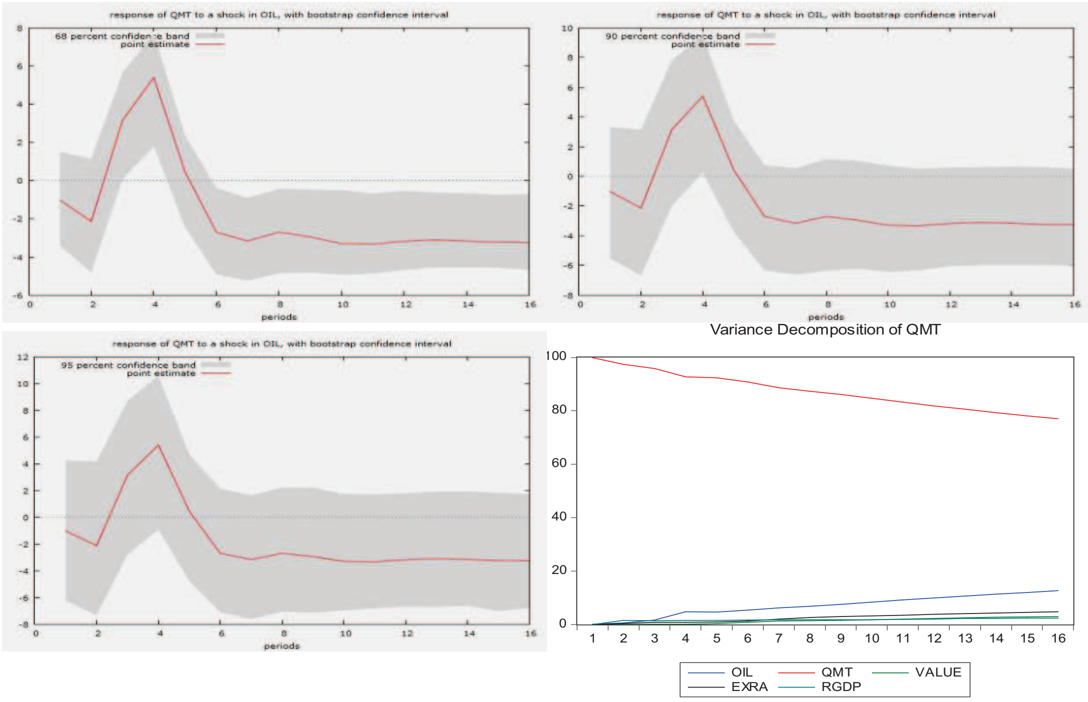
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4.2.2 C.I.S.

4.2.2.1 Russia

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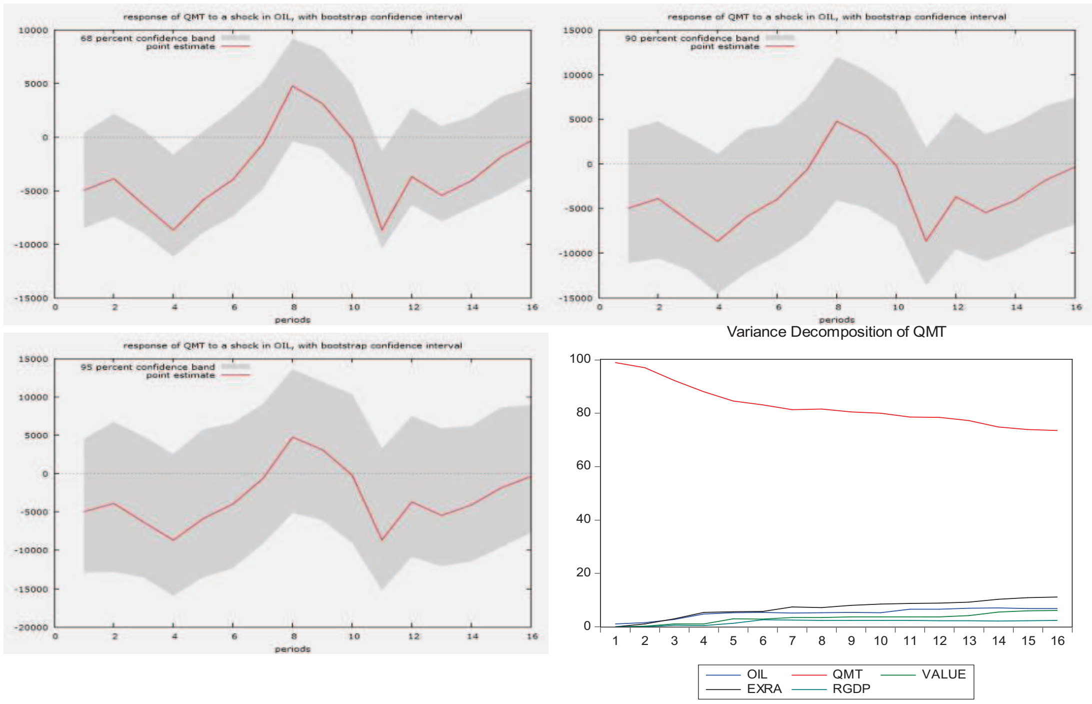

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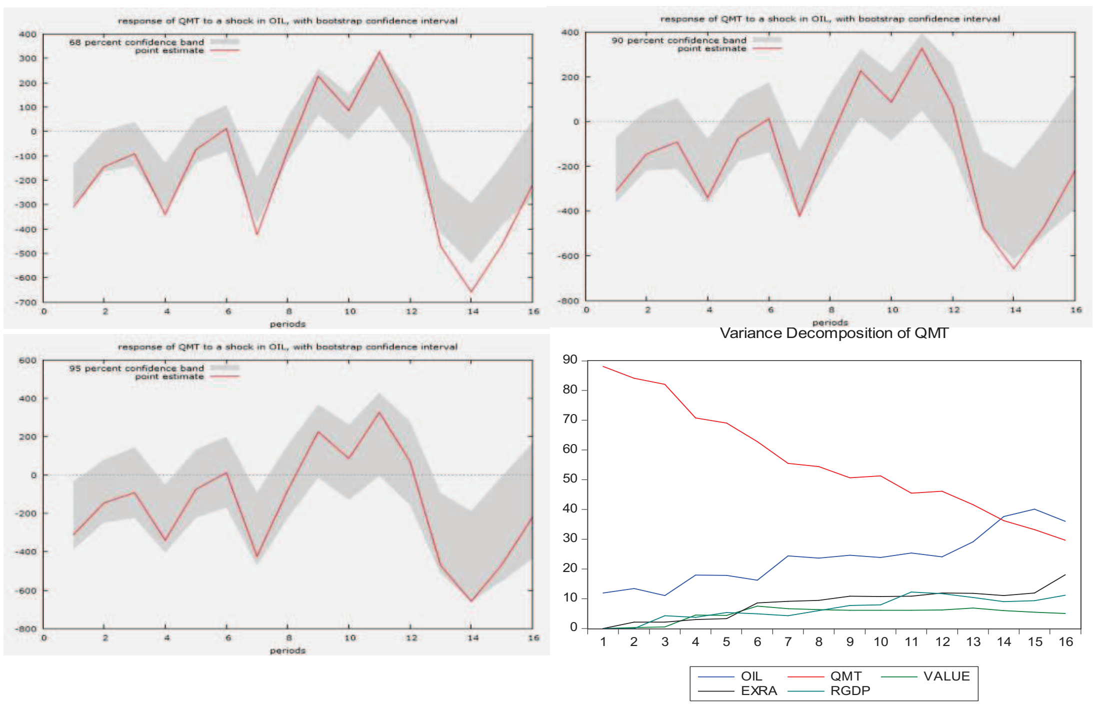

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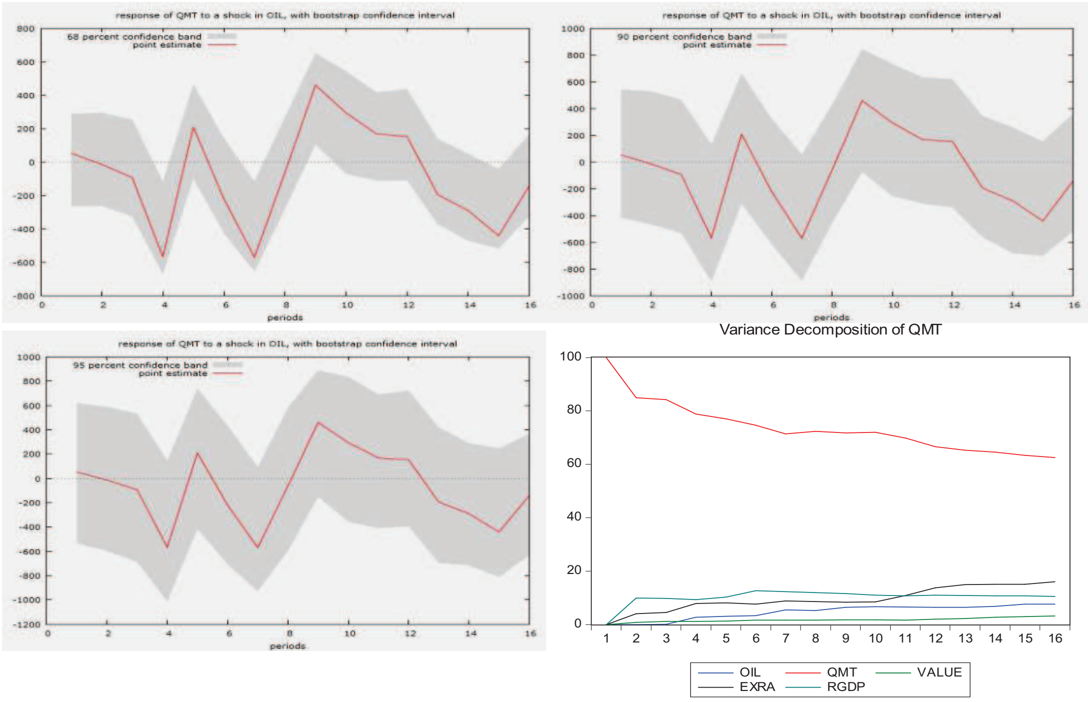
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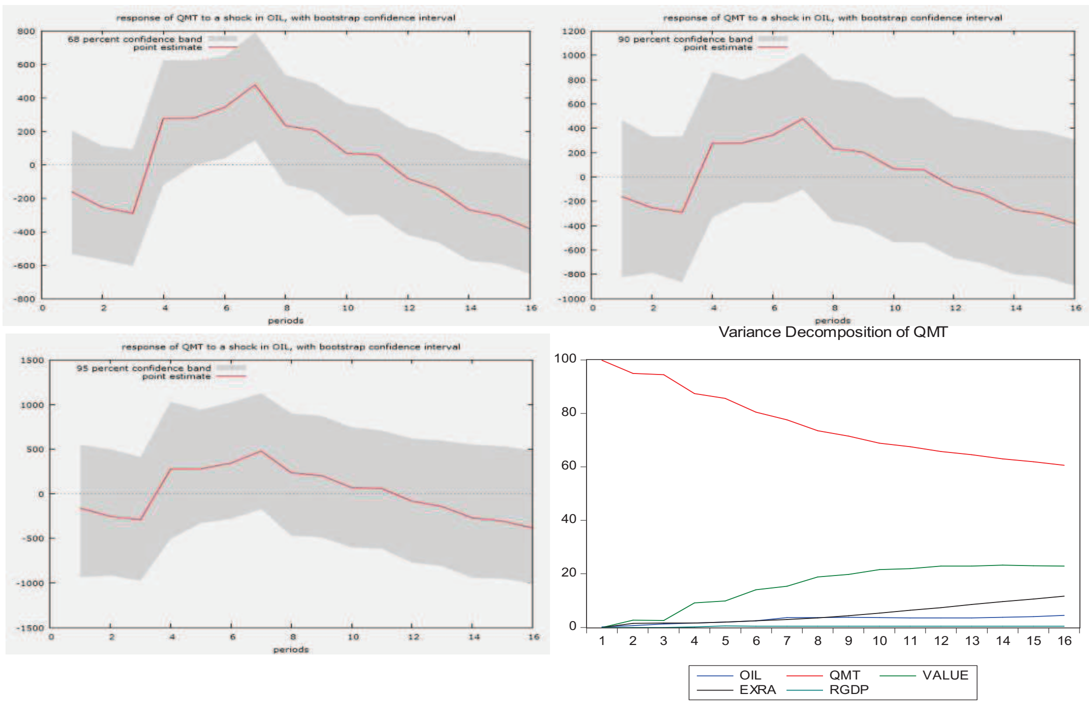
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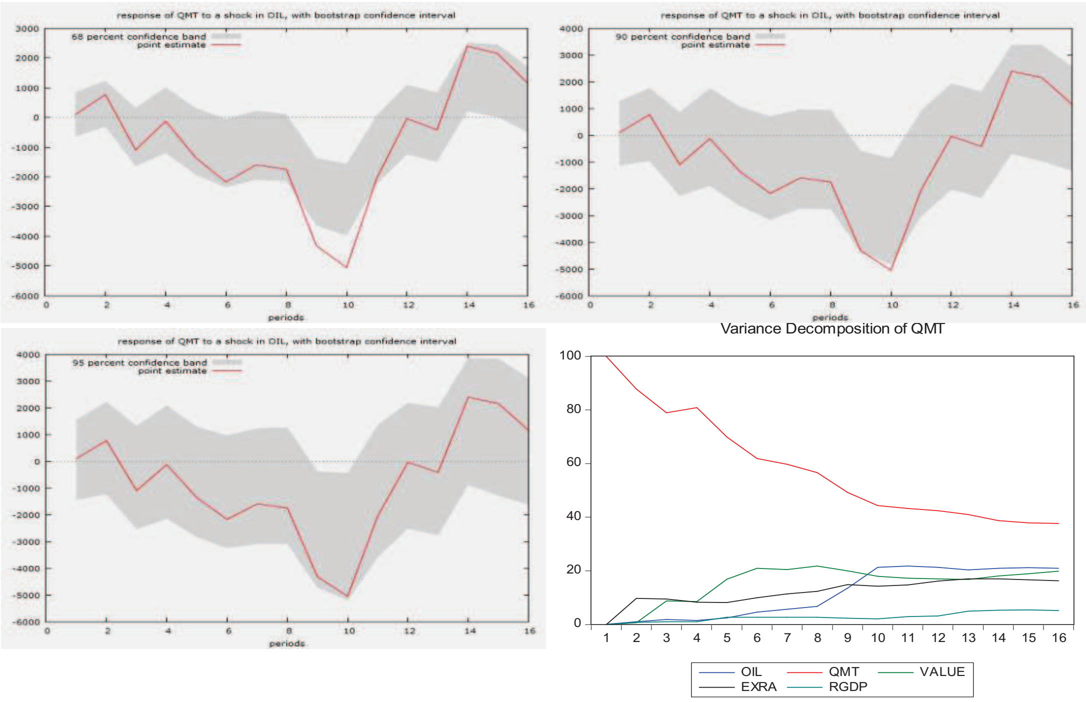
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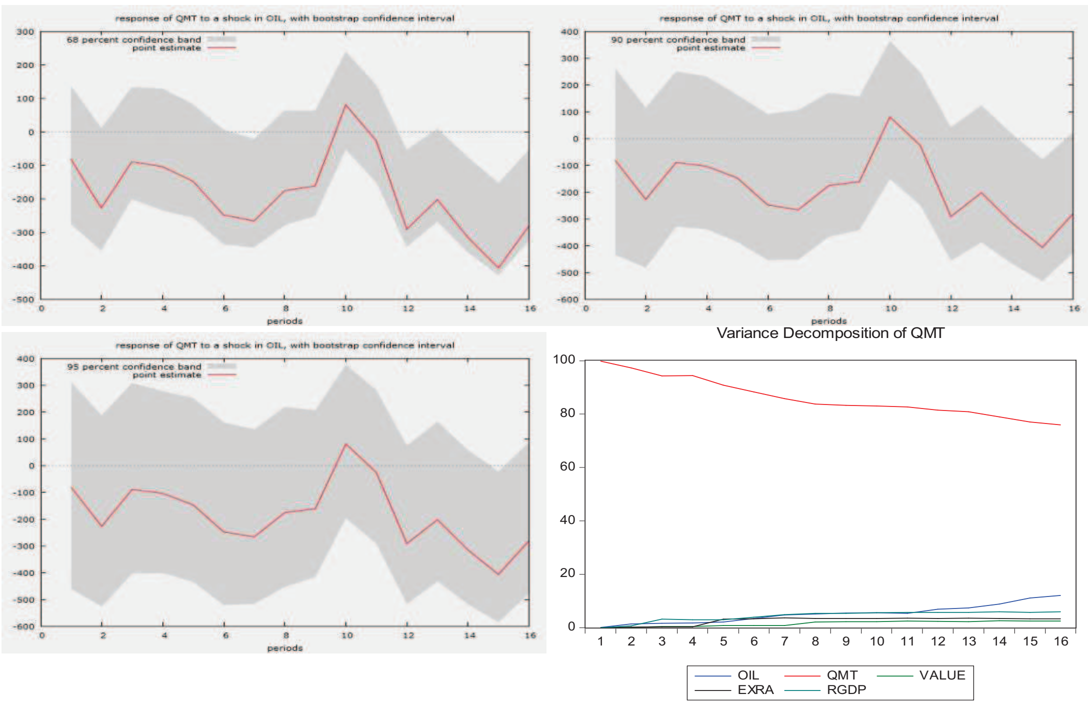
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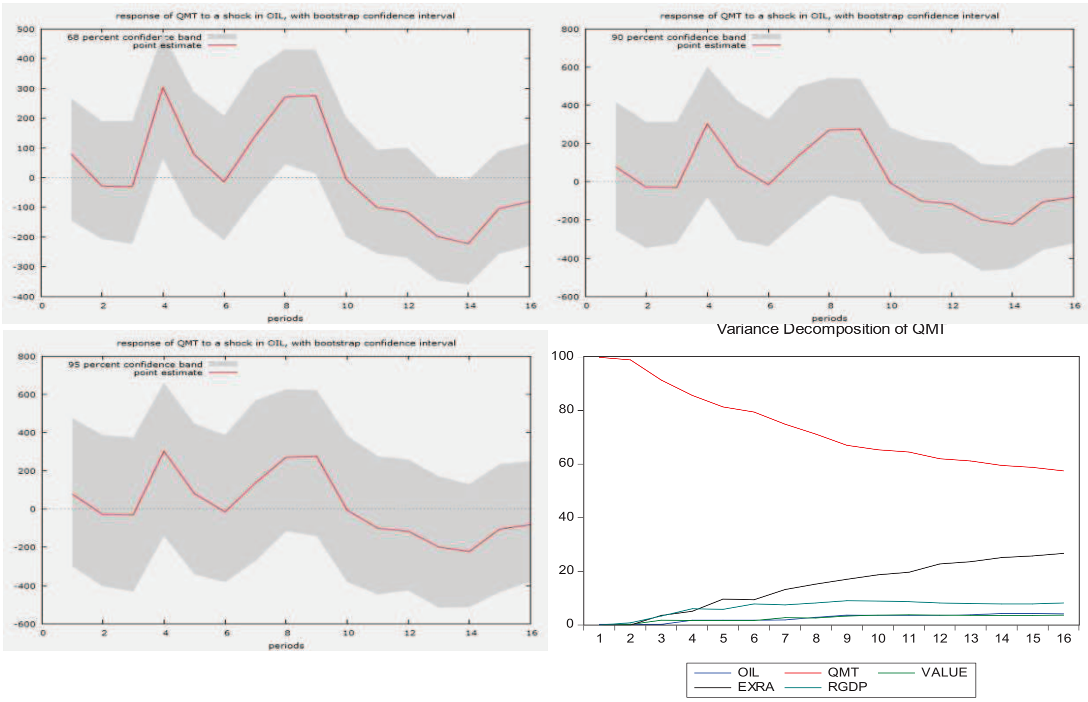
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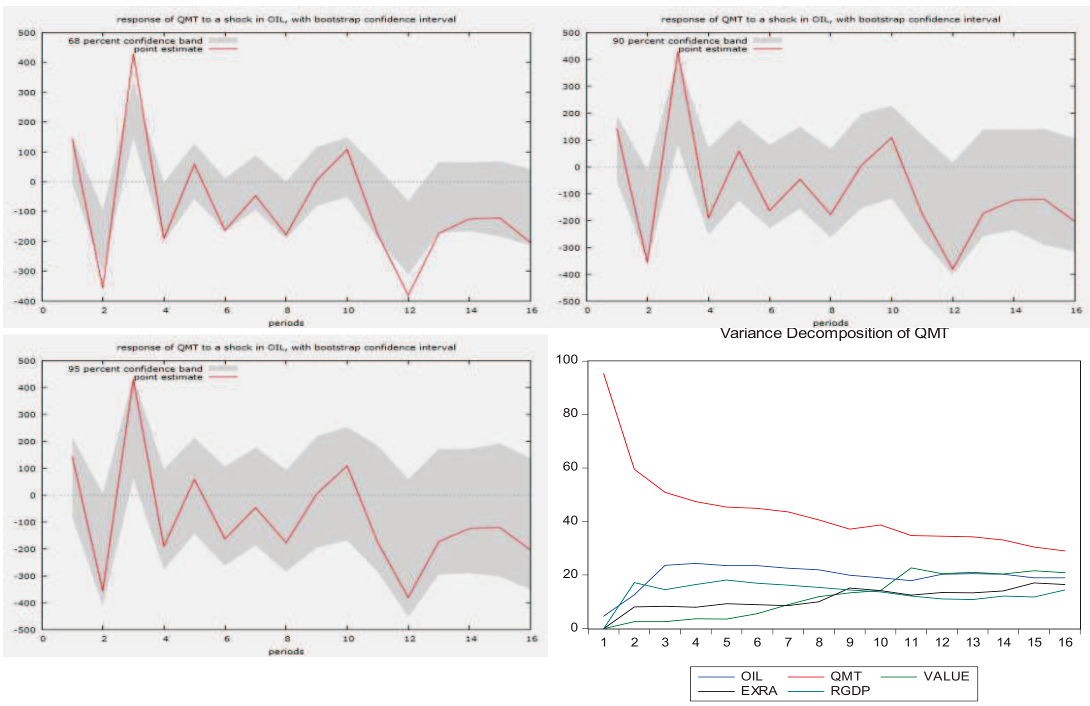
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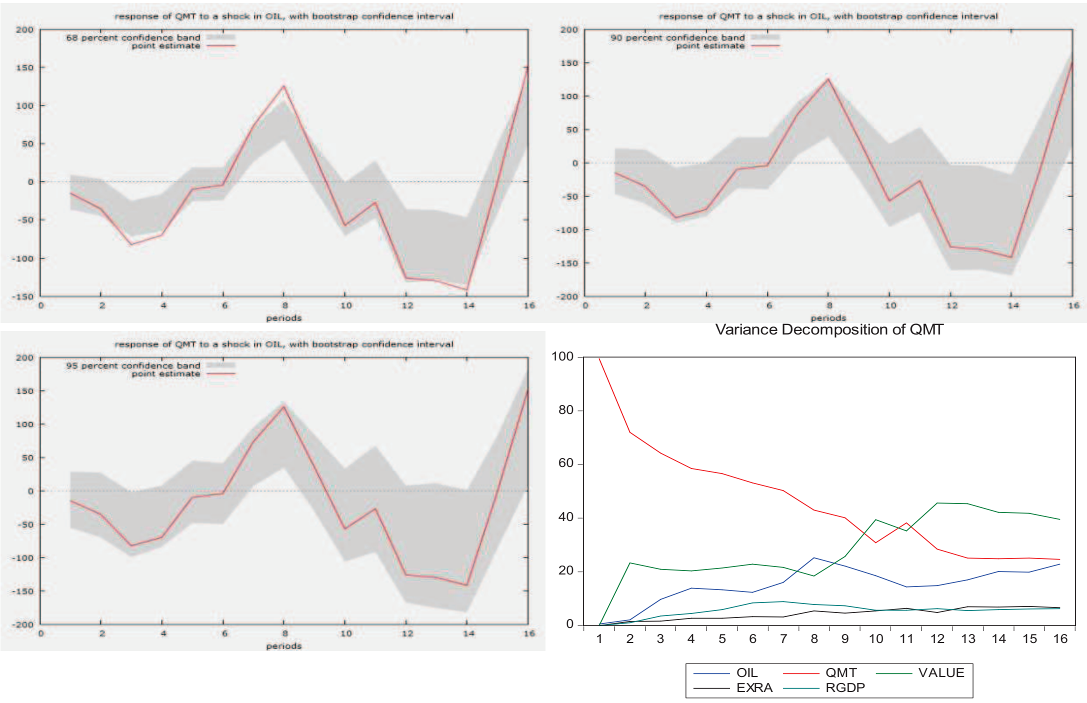
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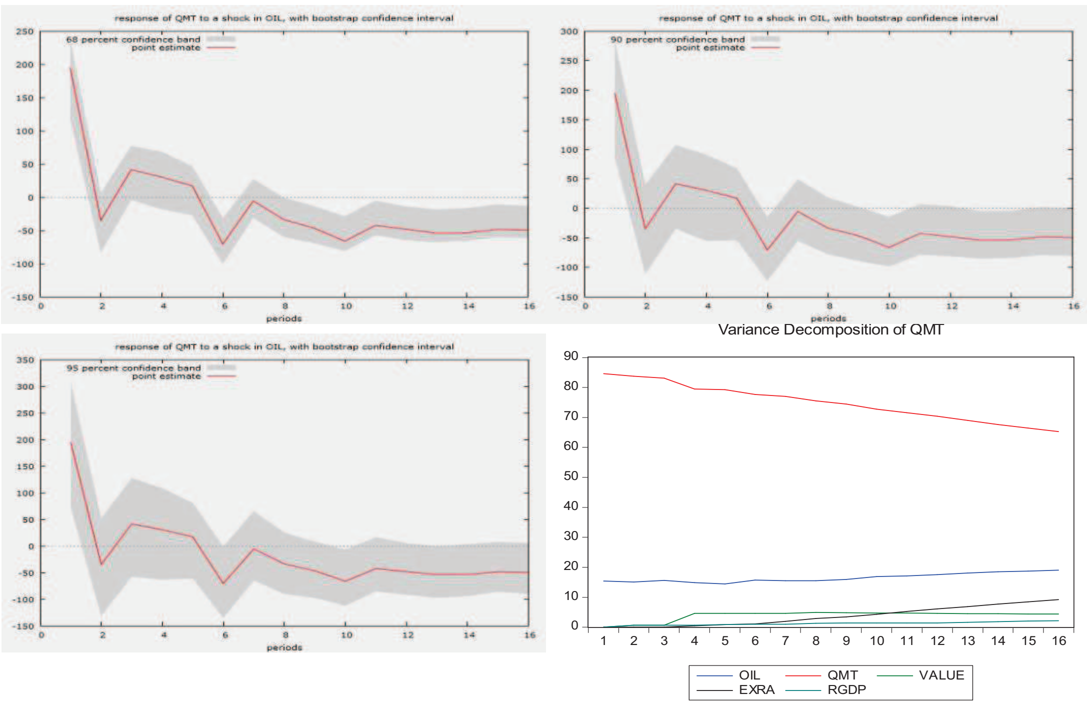
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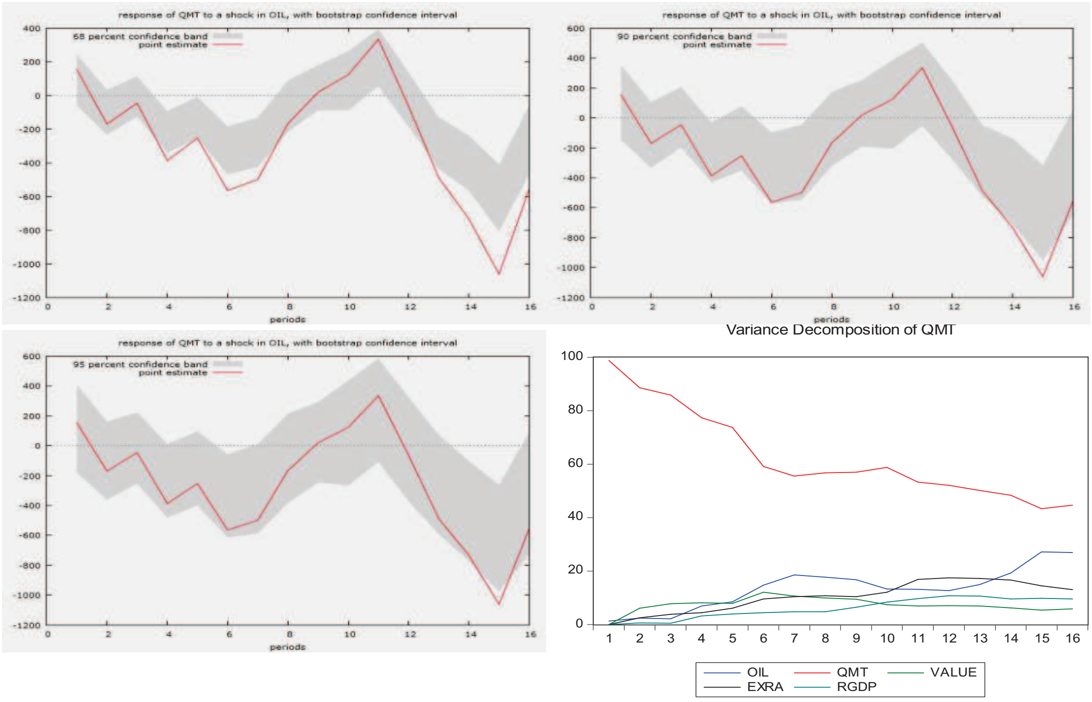
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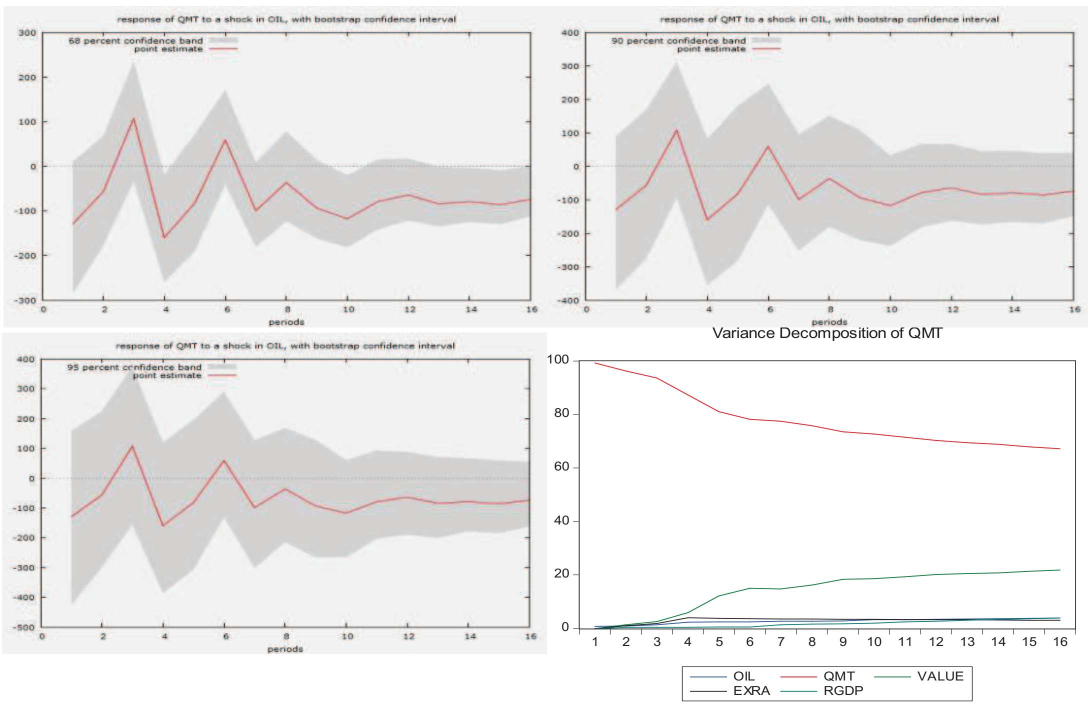
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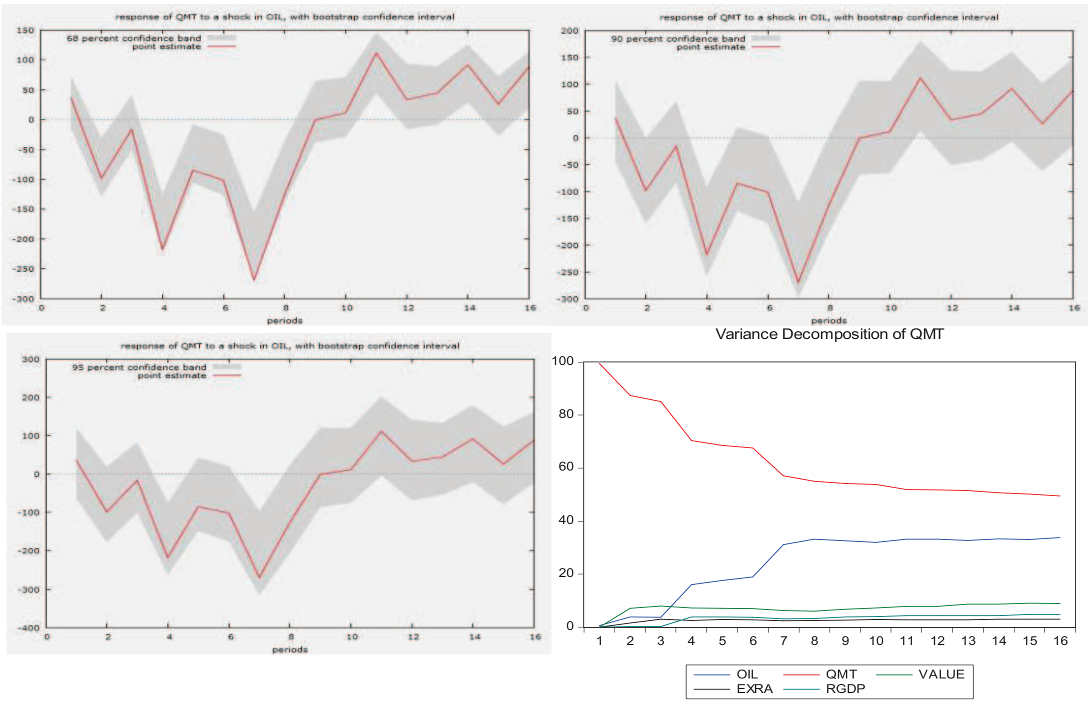
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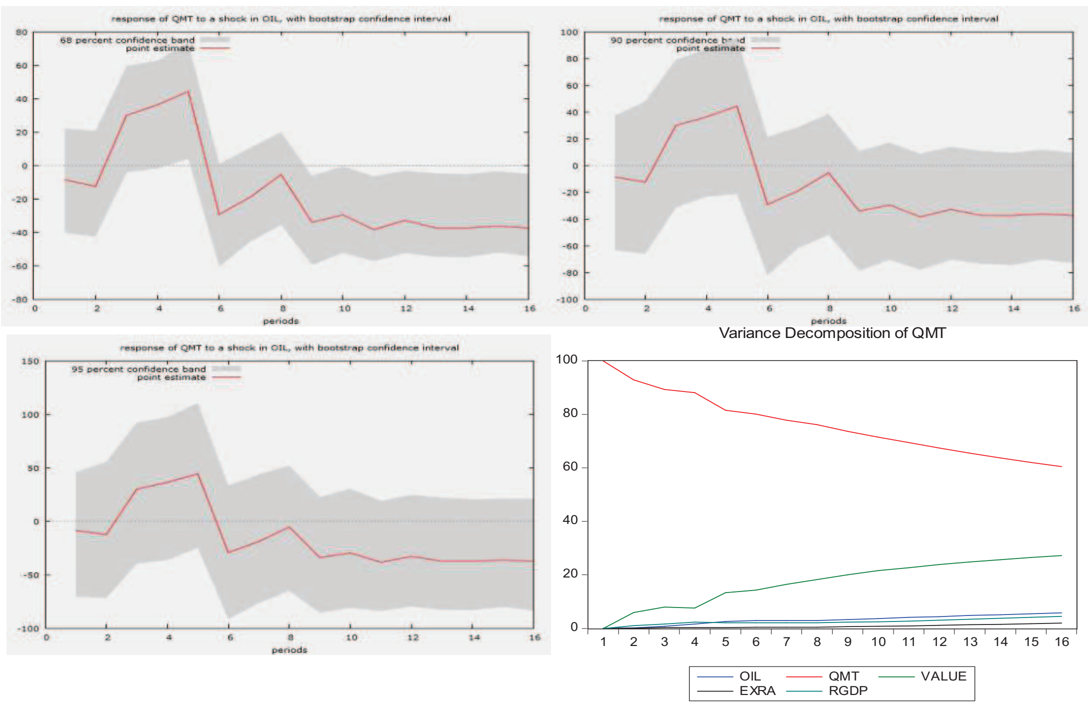
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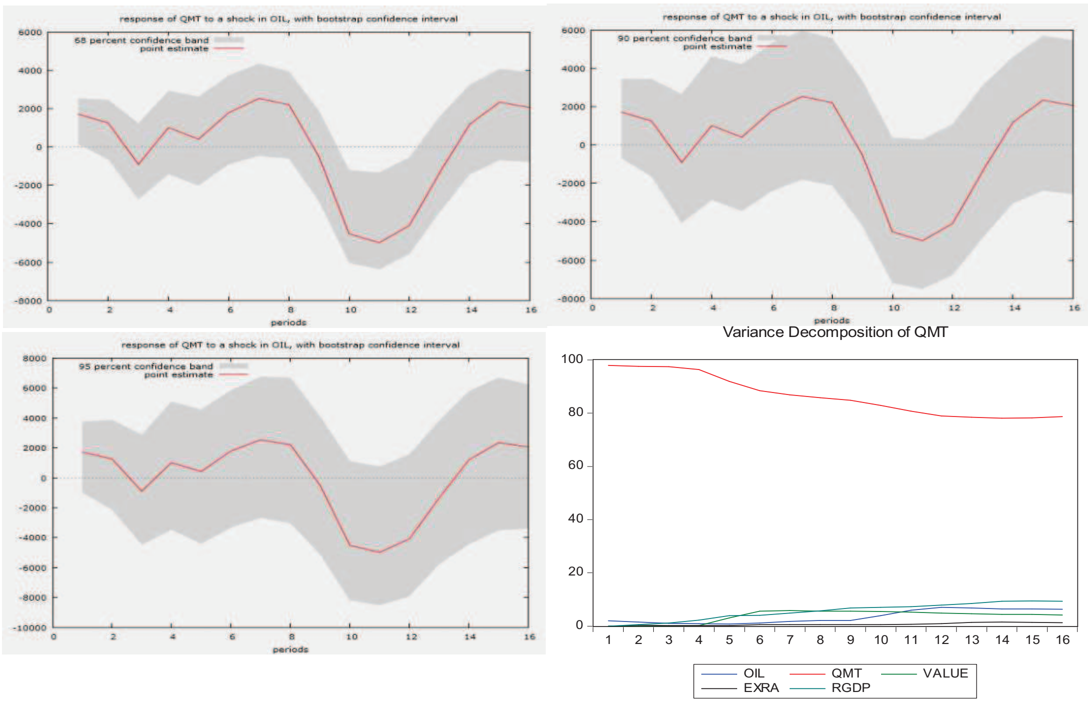
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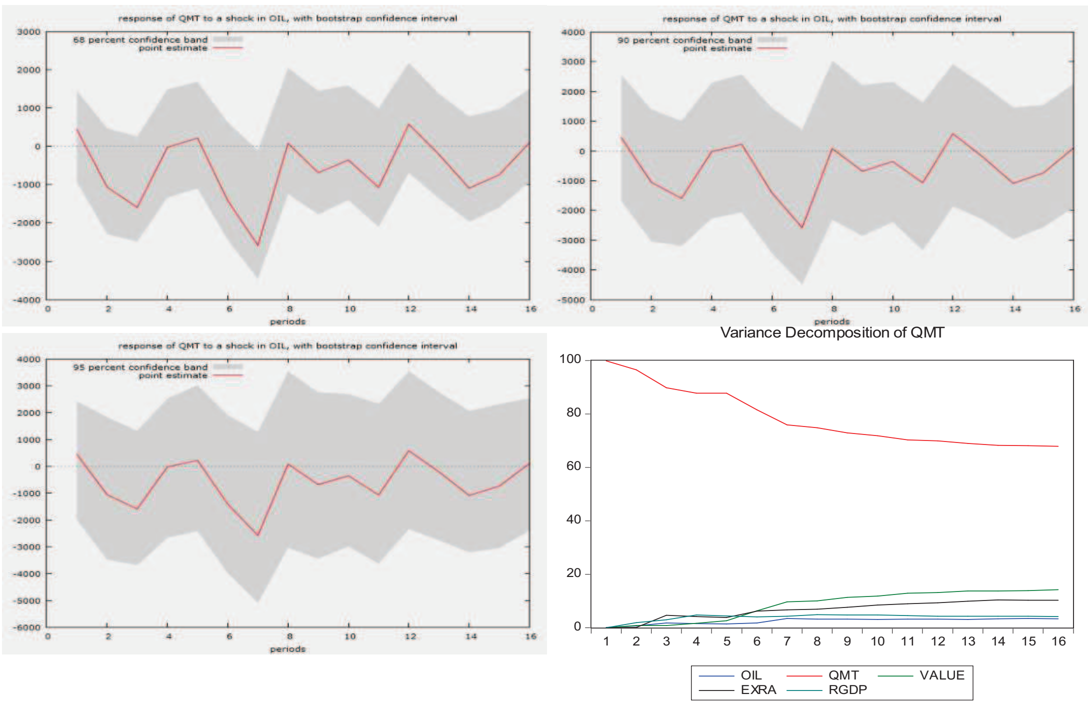
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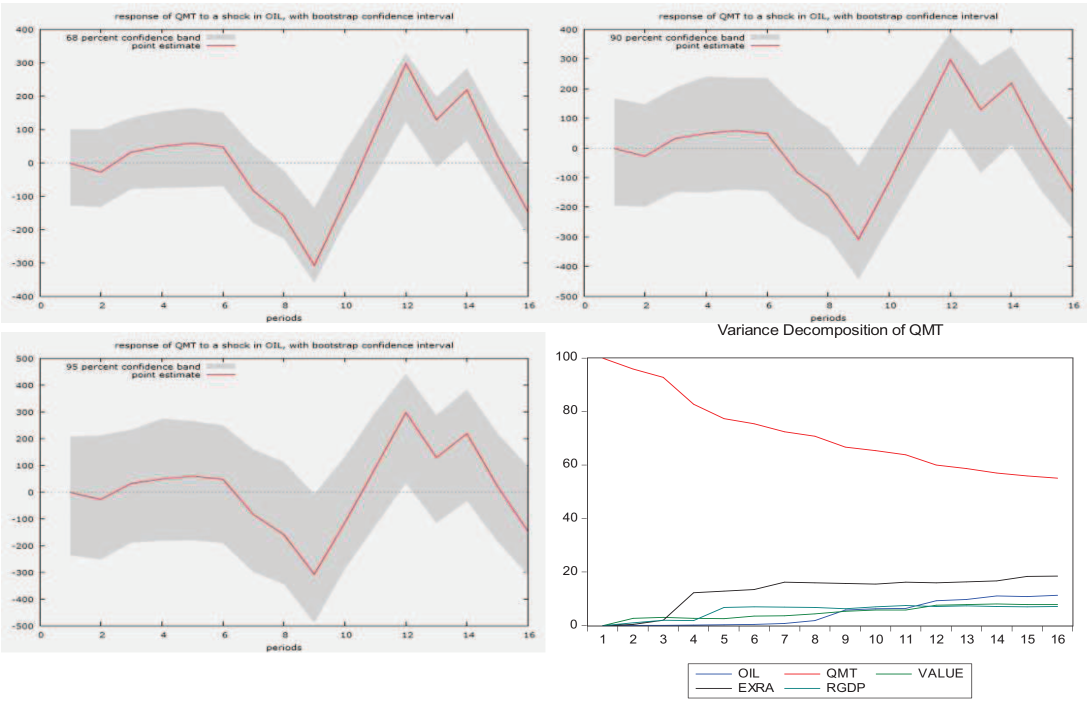
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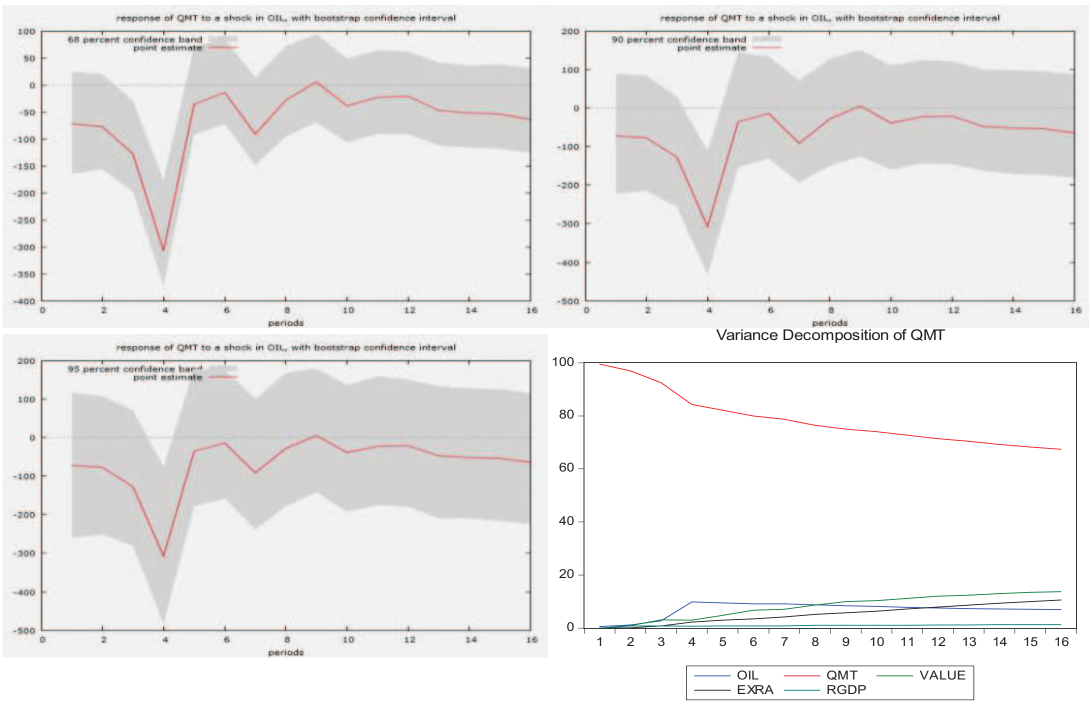
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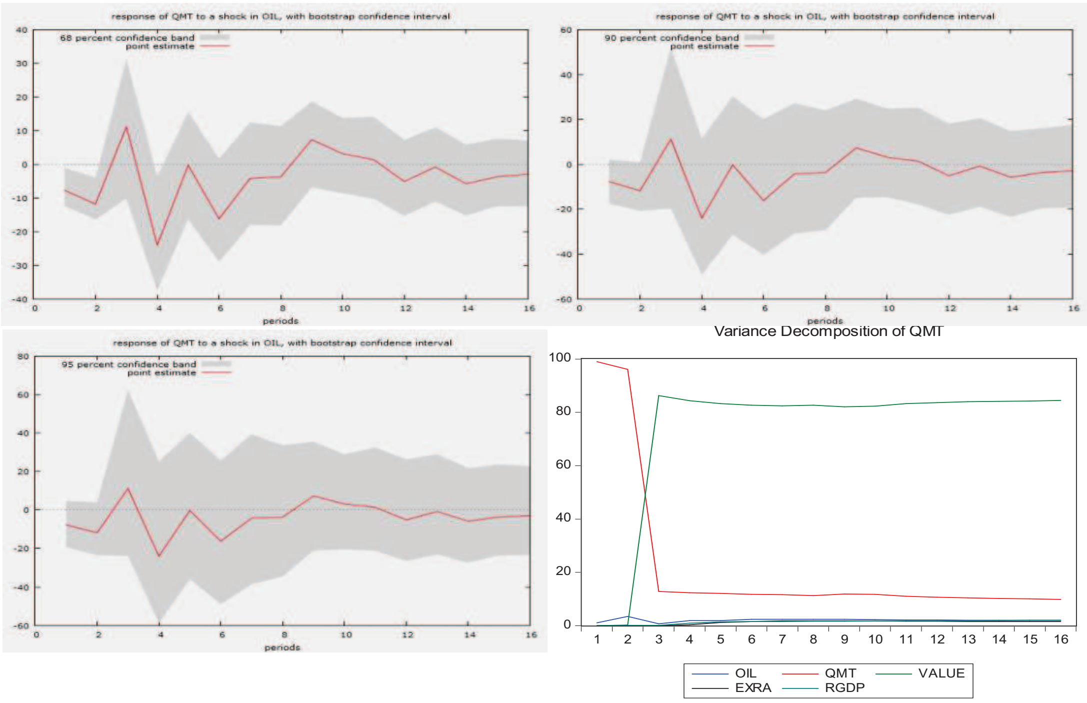

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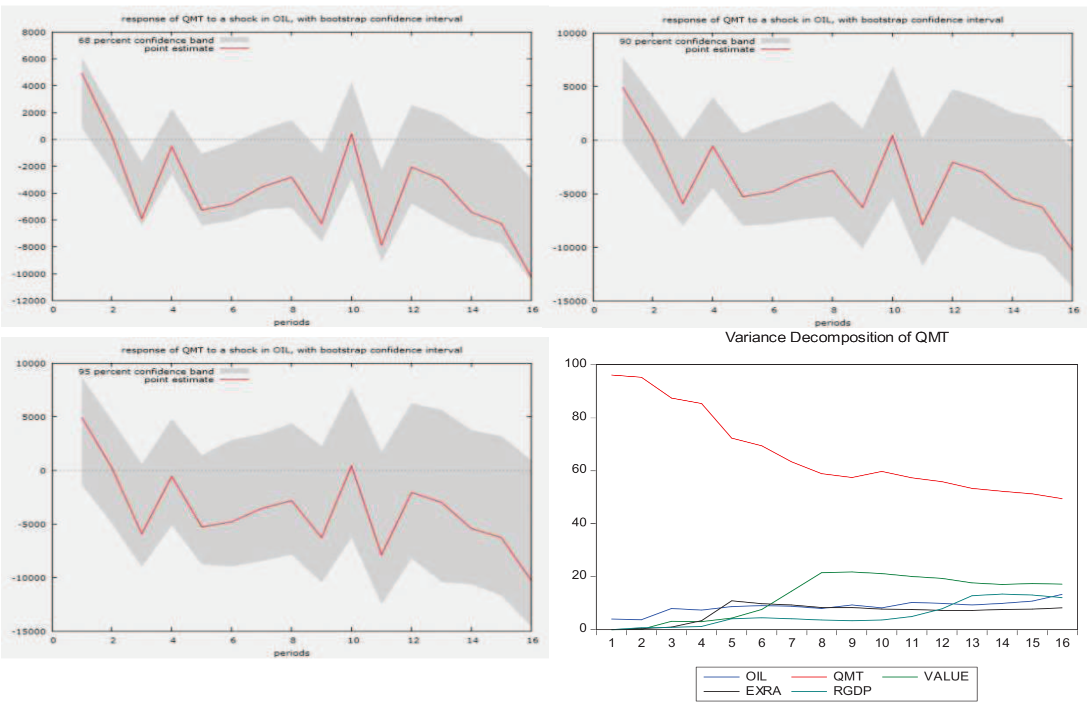

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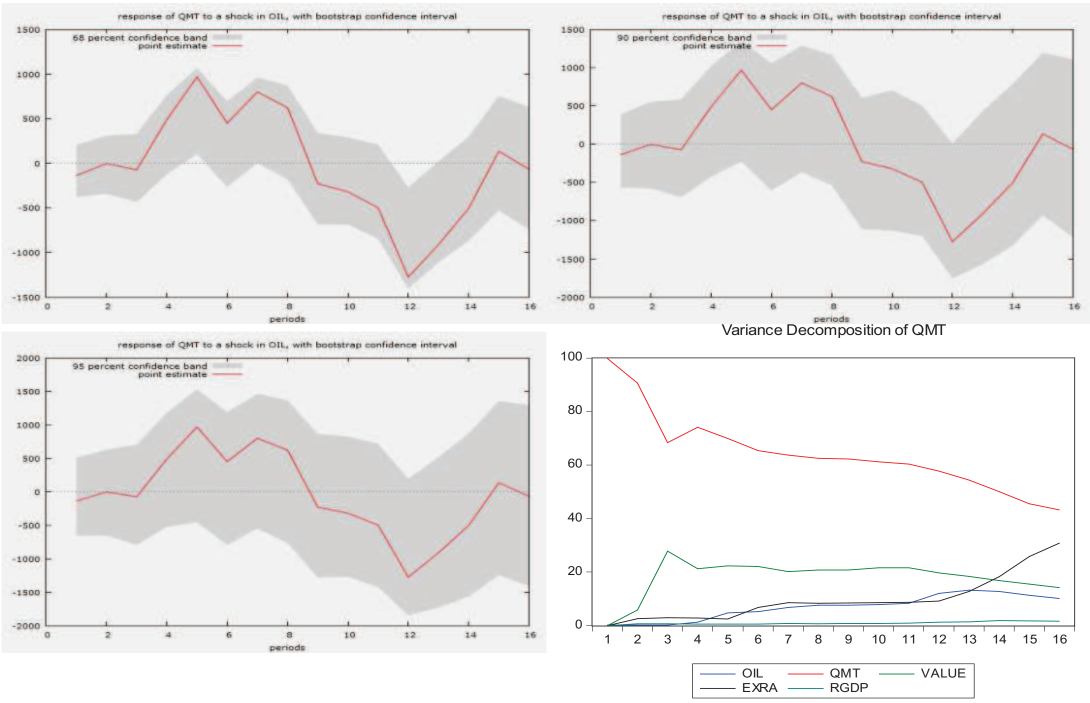
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OIL
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VALUE
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RGDP

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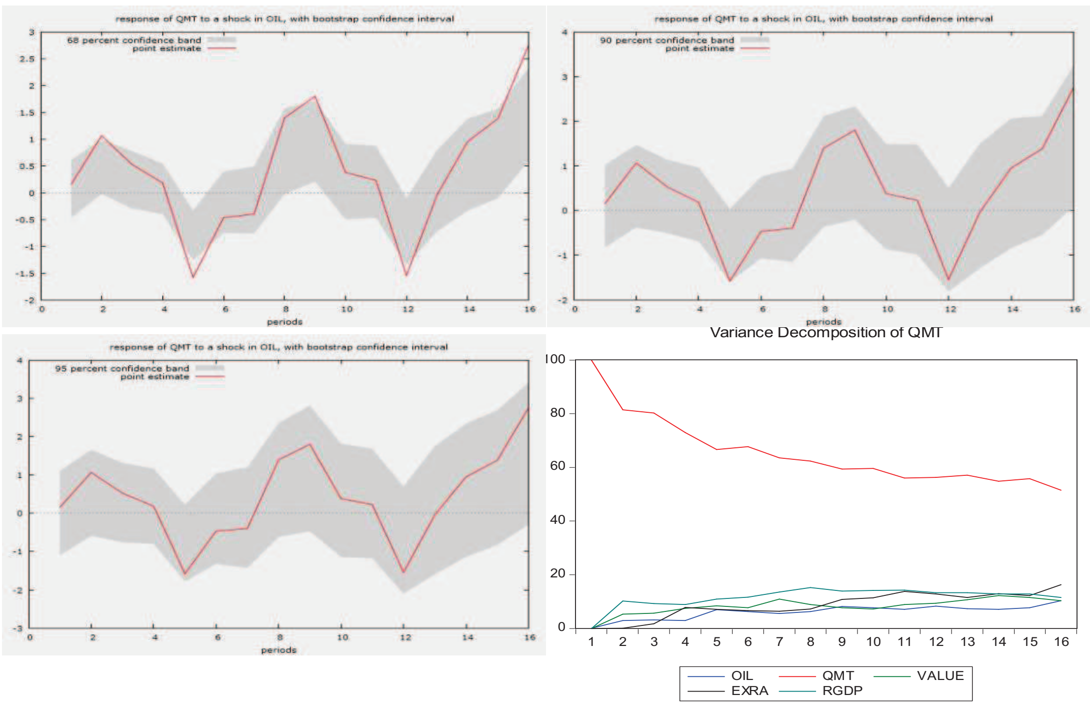
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OIL
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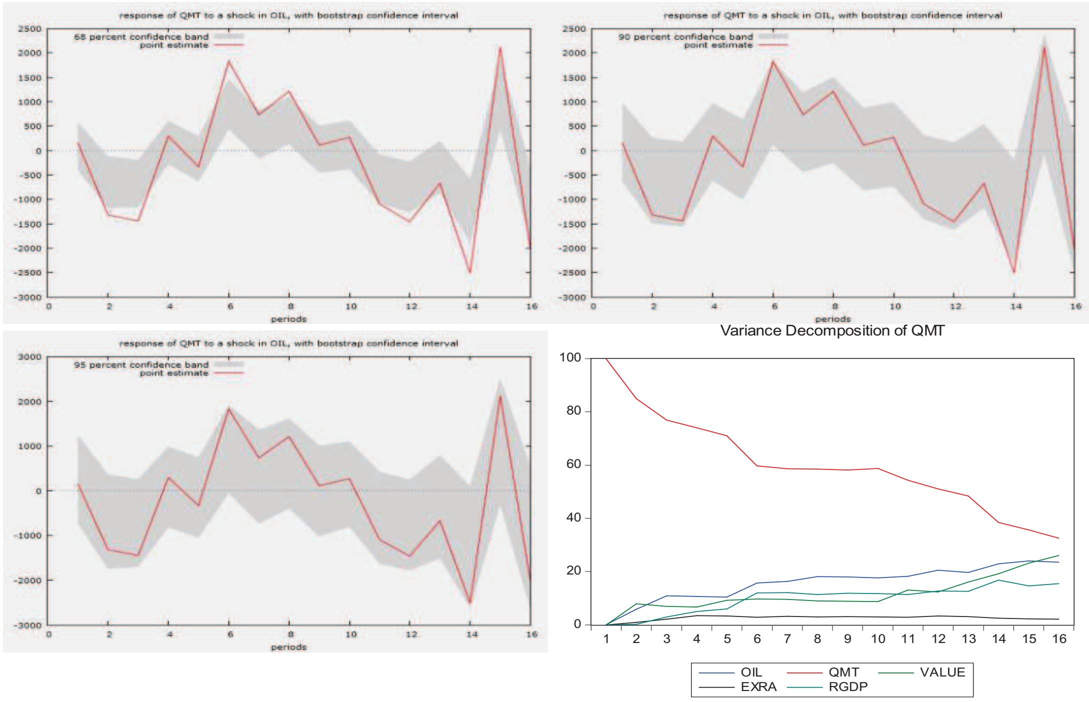
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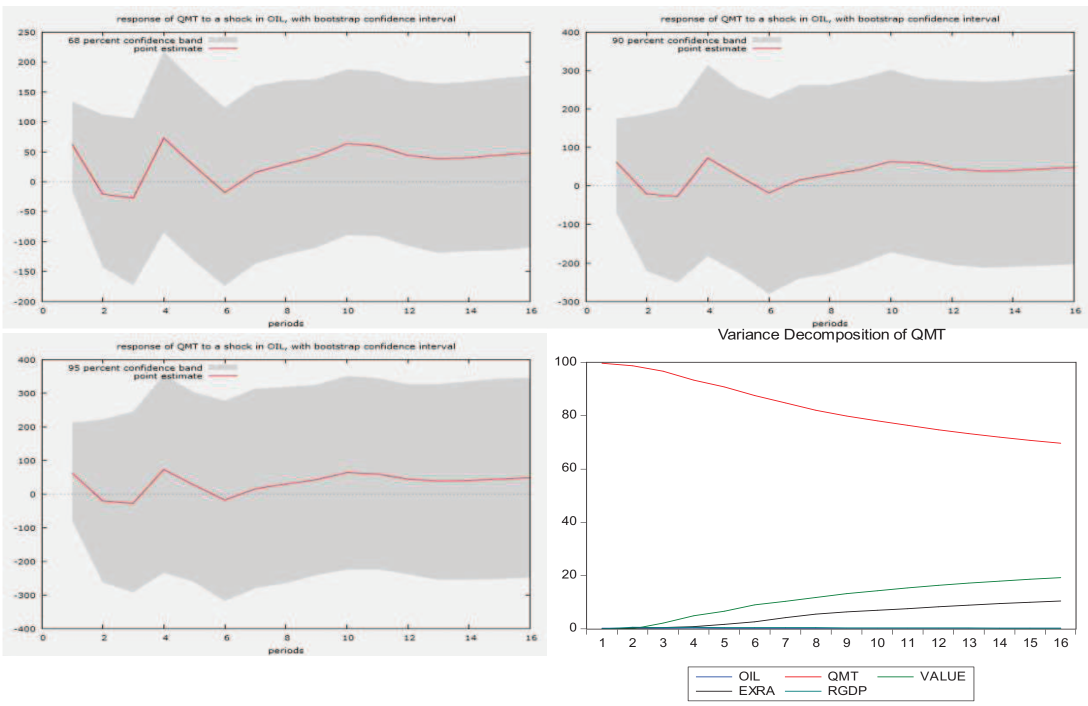
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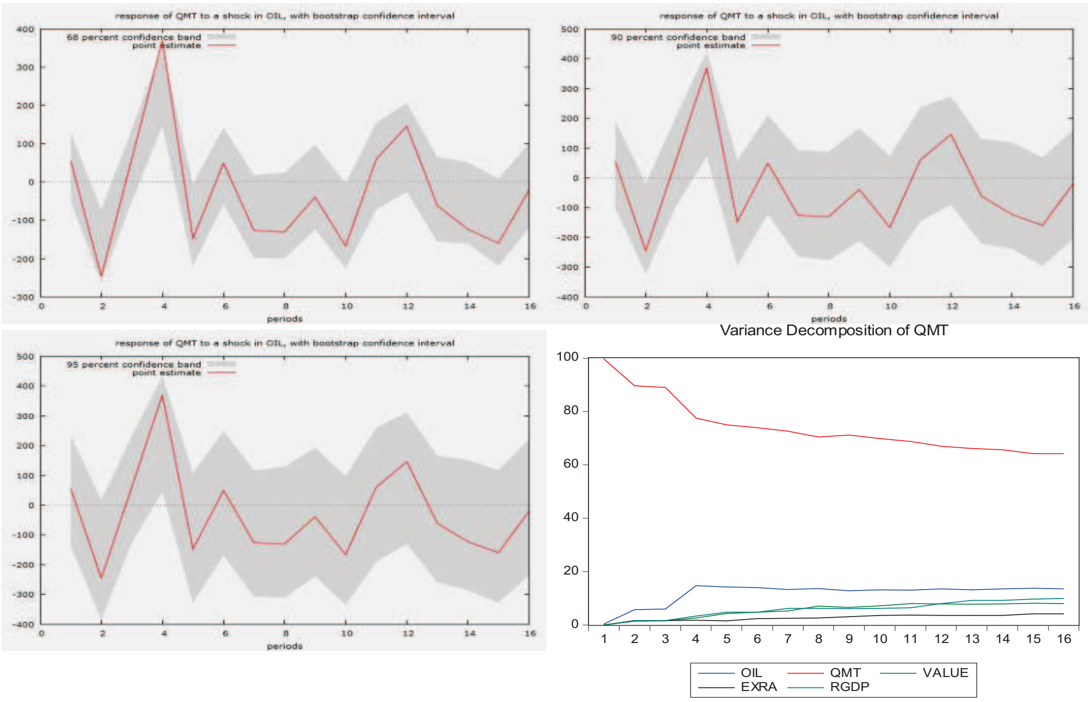
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OIL
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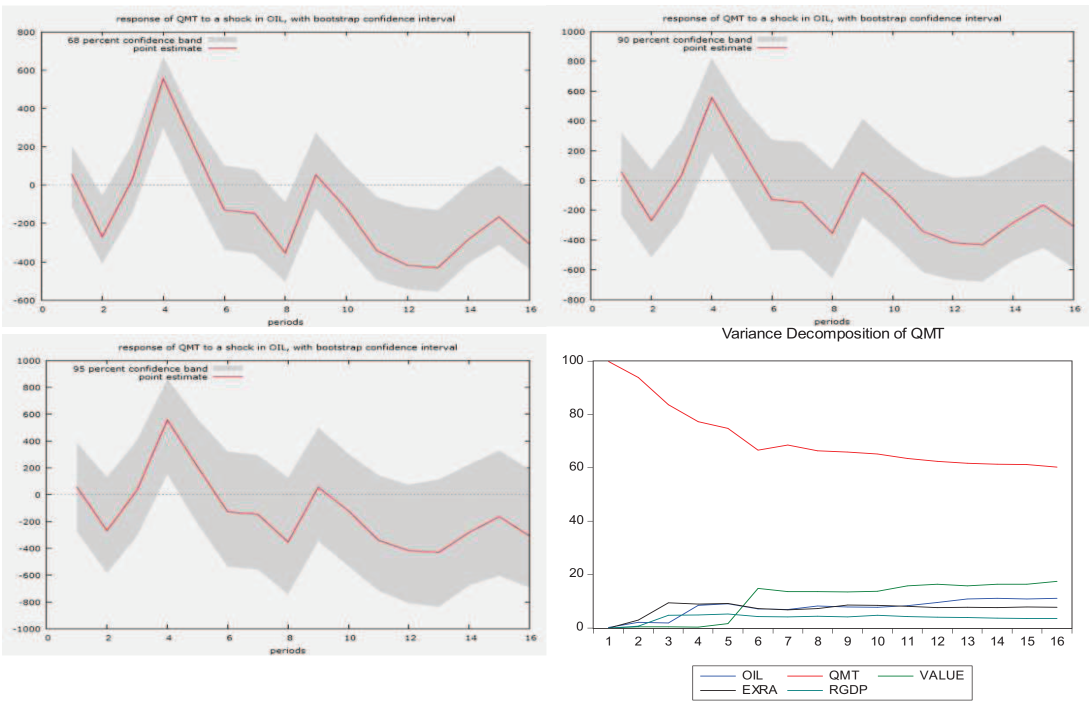
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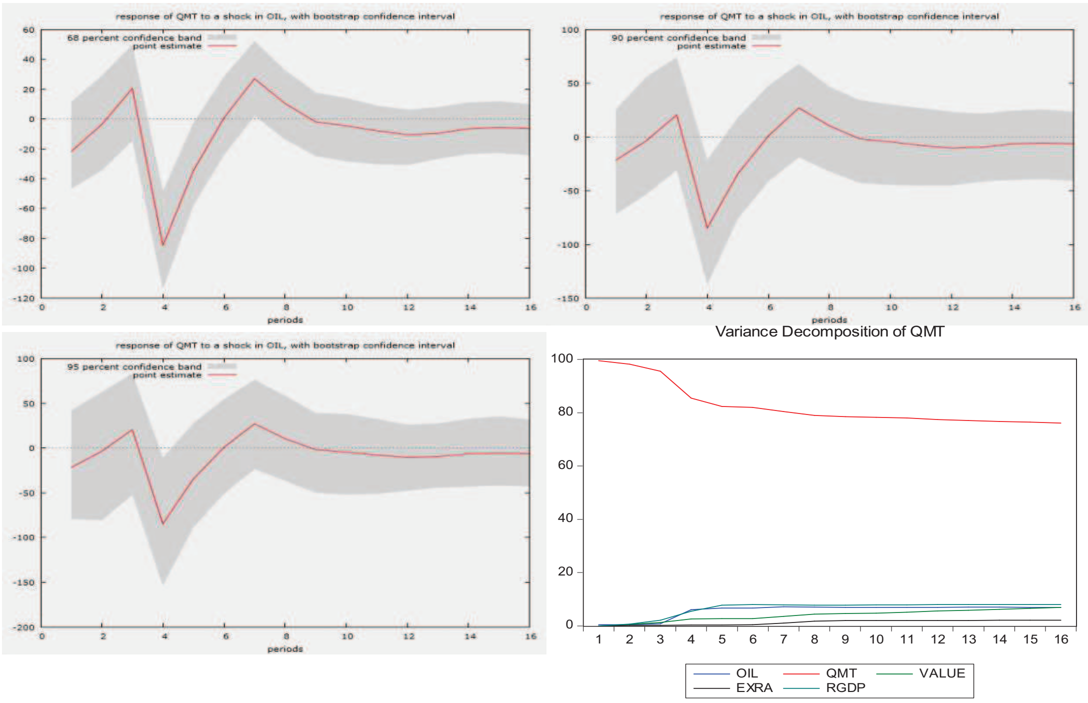
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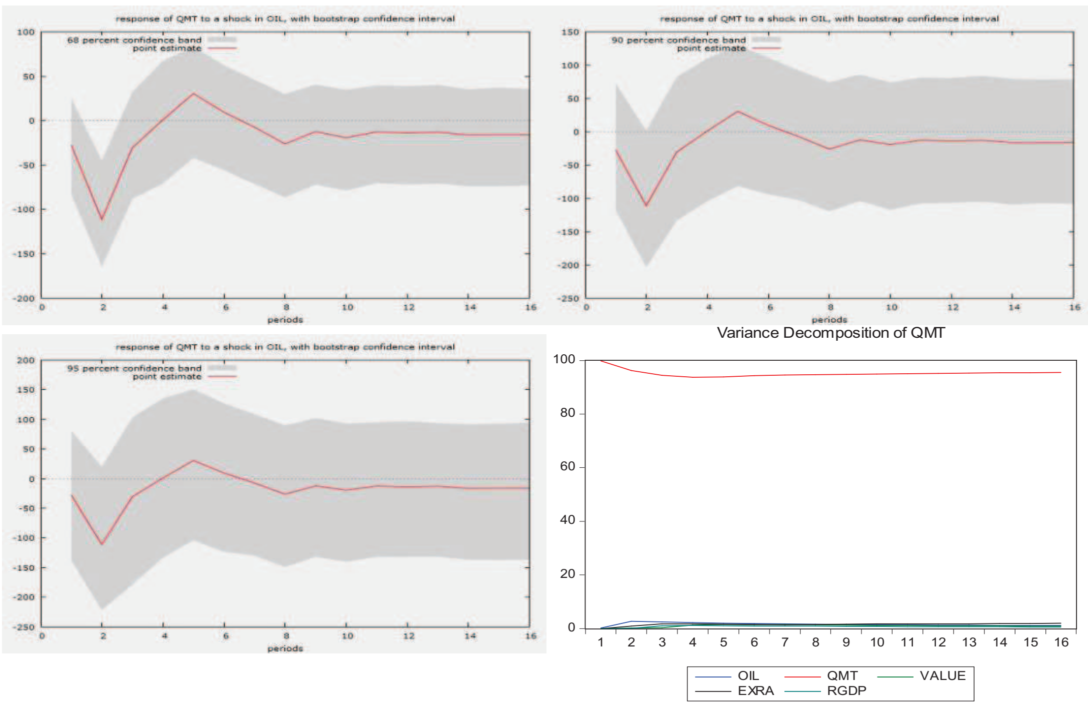
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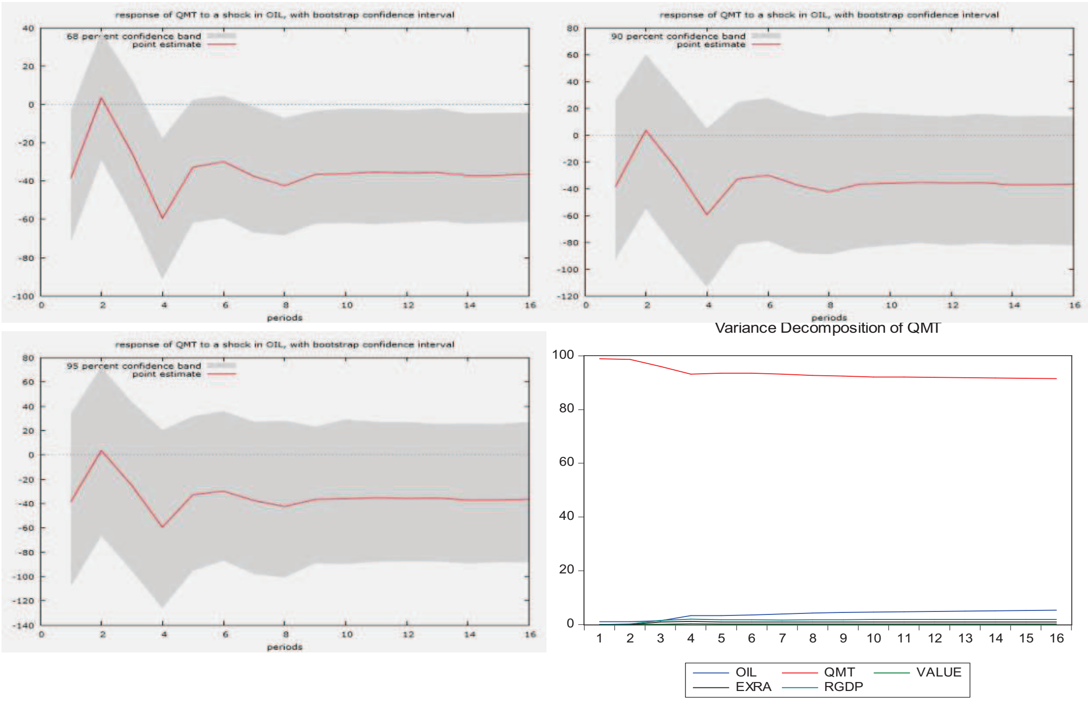
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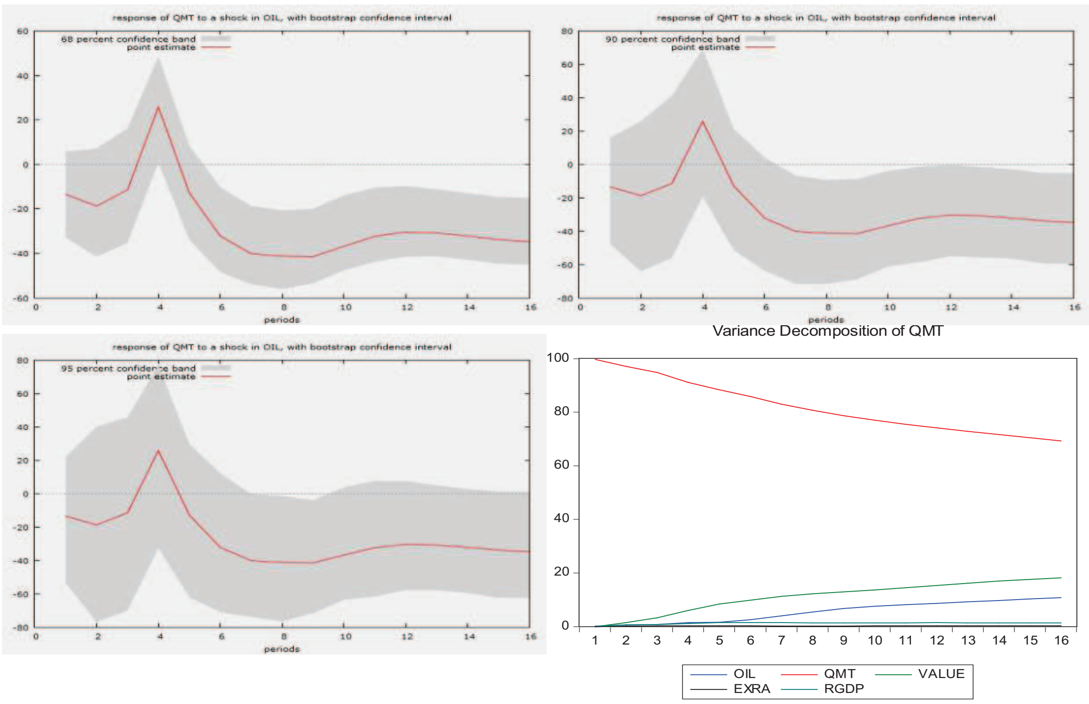
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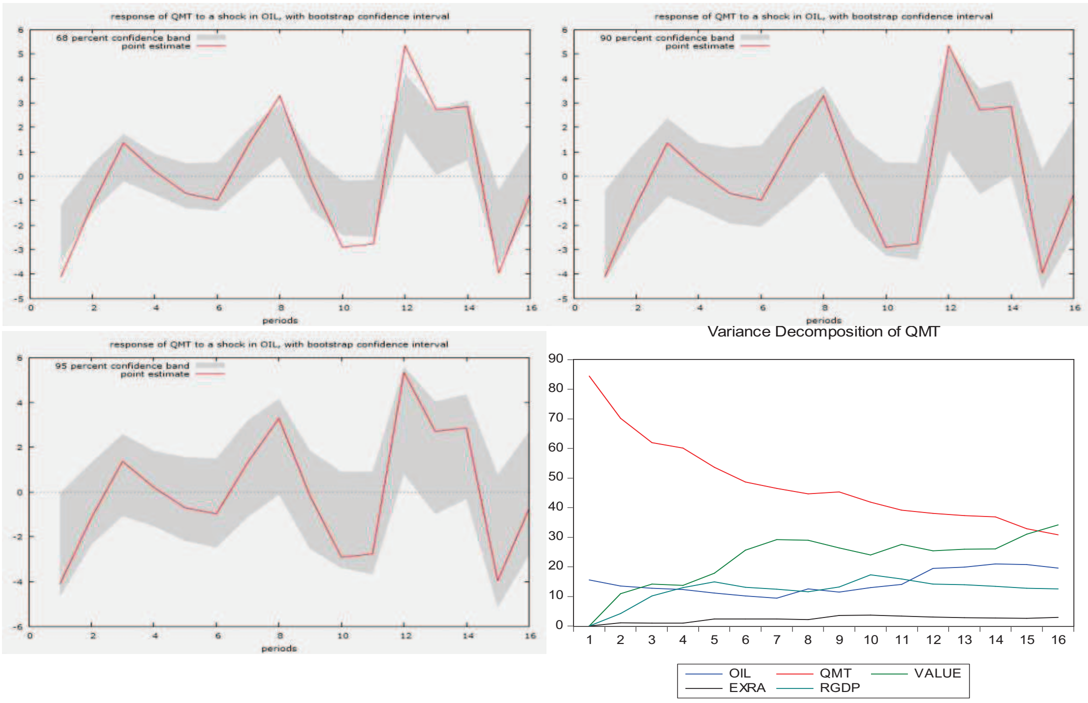
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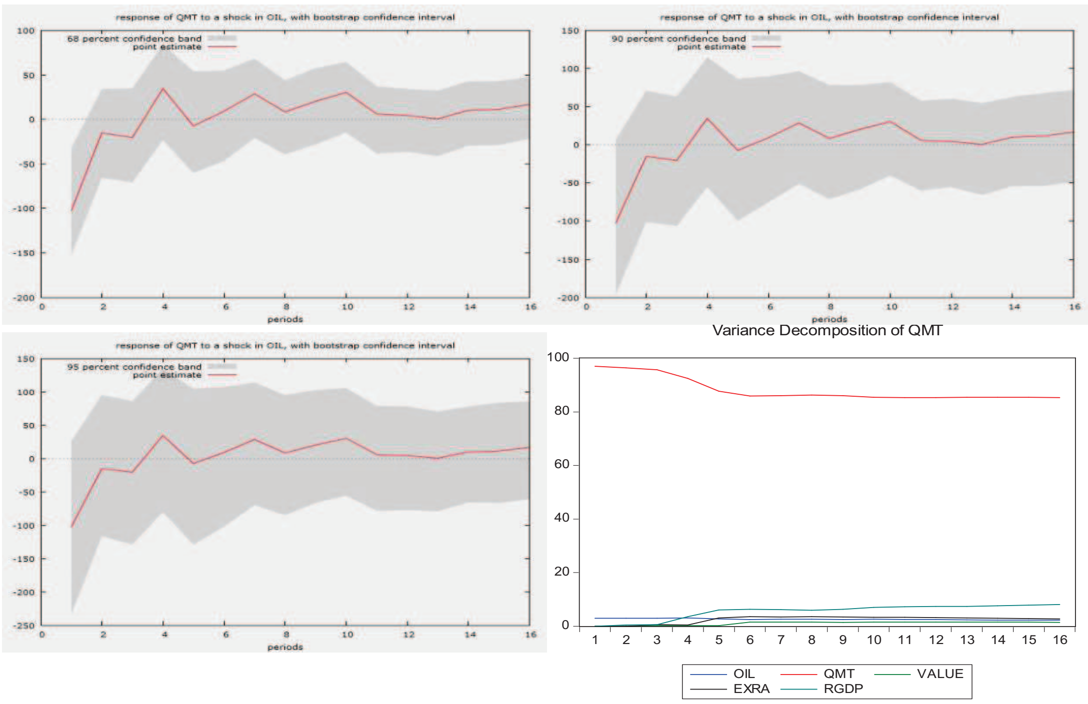
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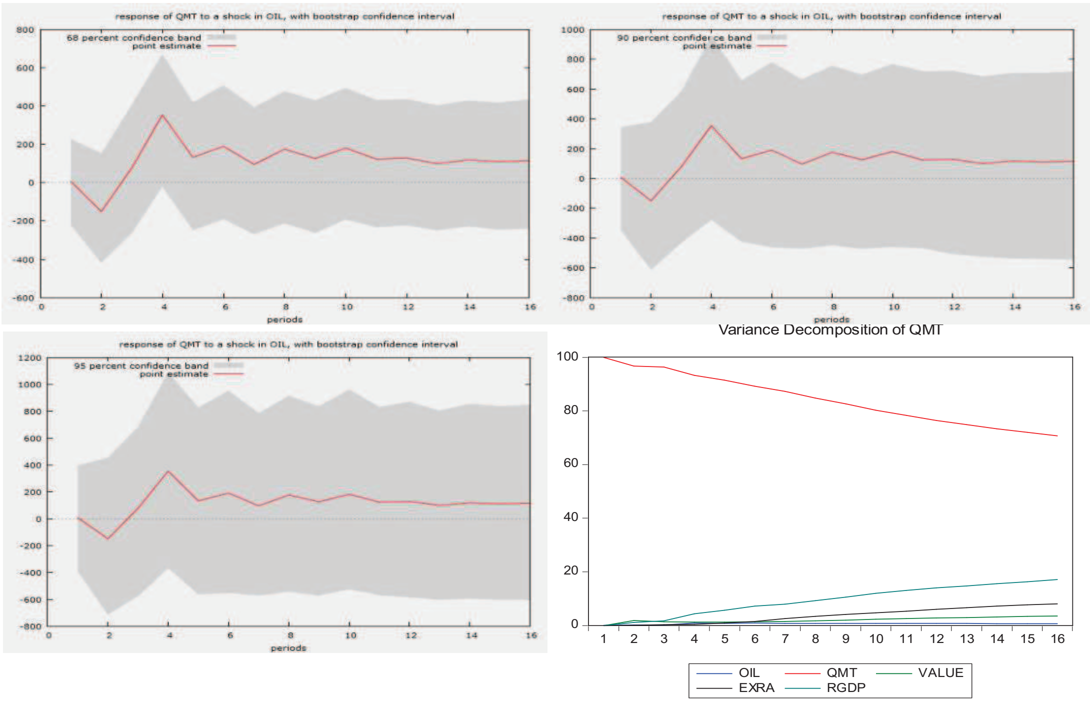
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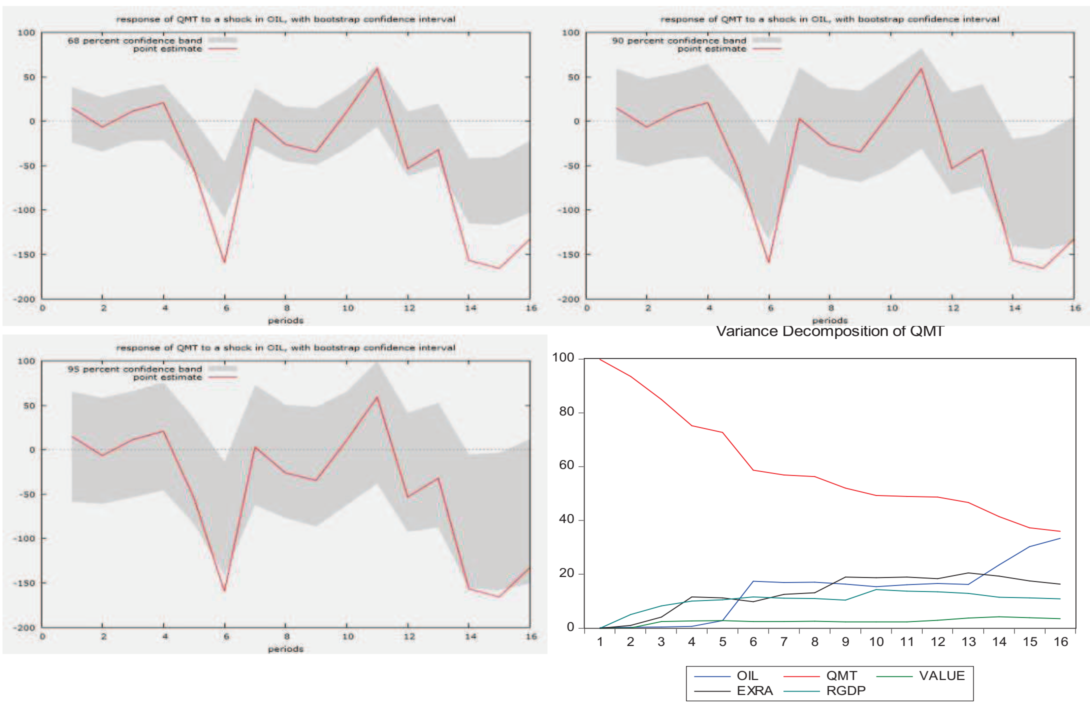
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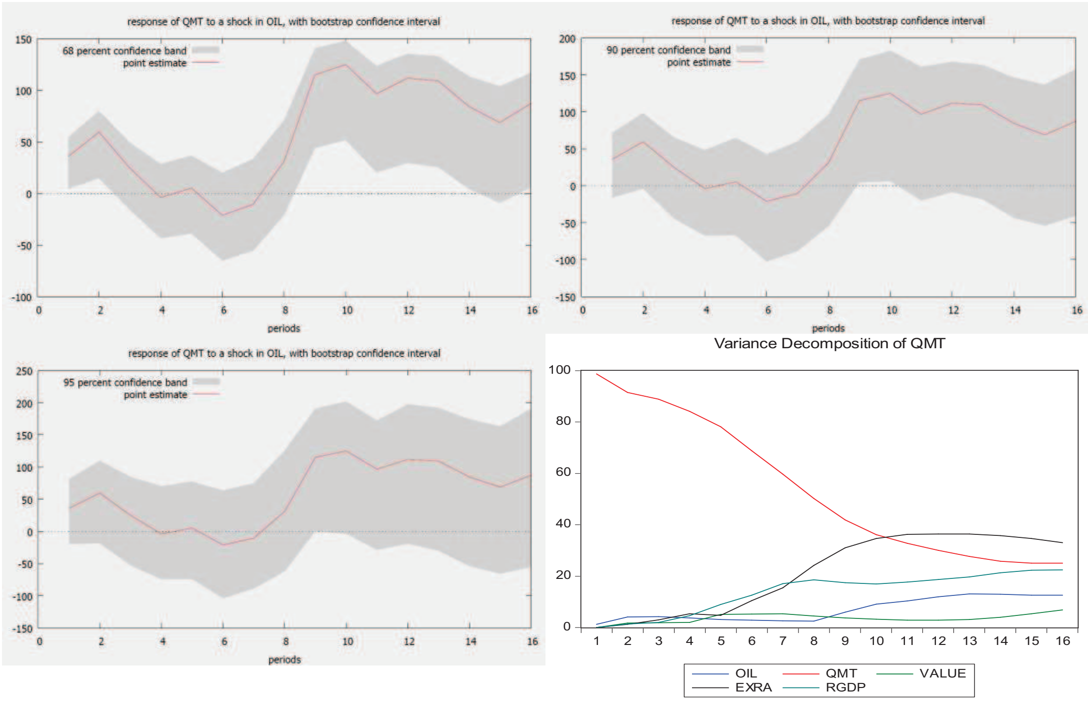
4.2.3 North America

4.2.3.1 Canada

1A



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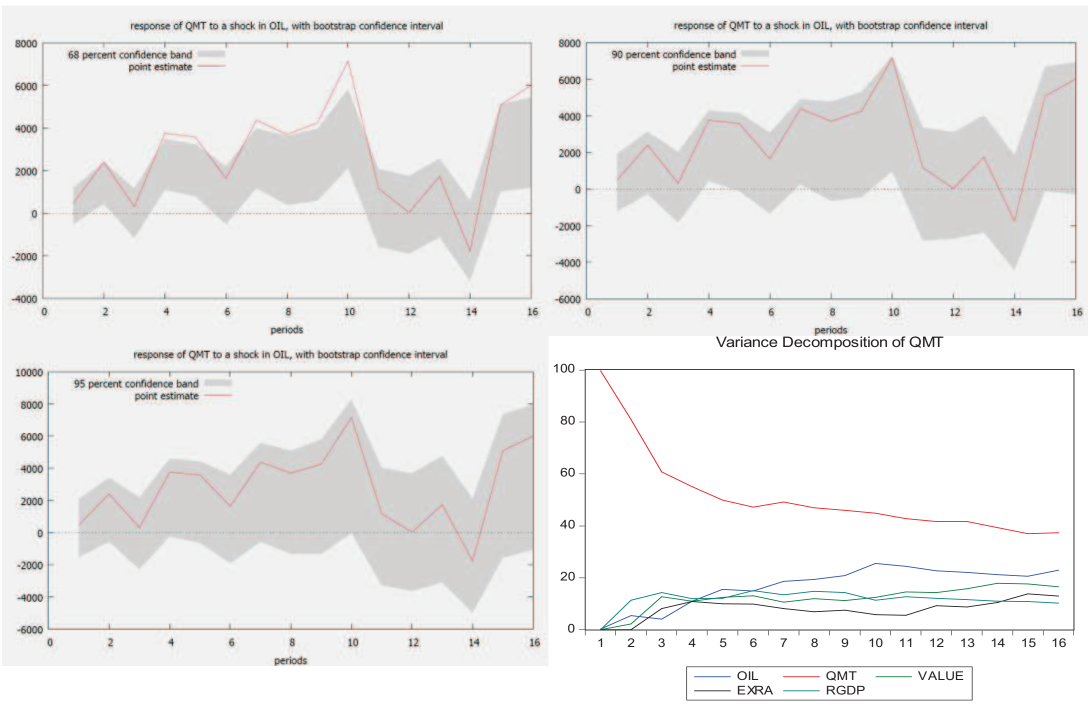

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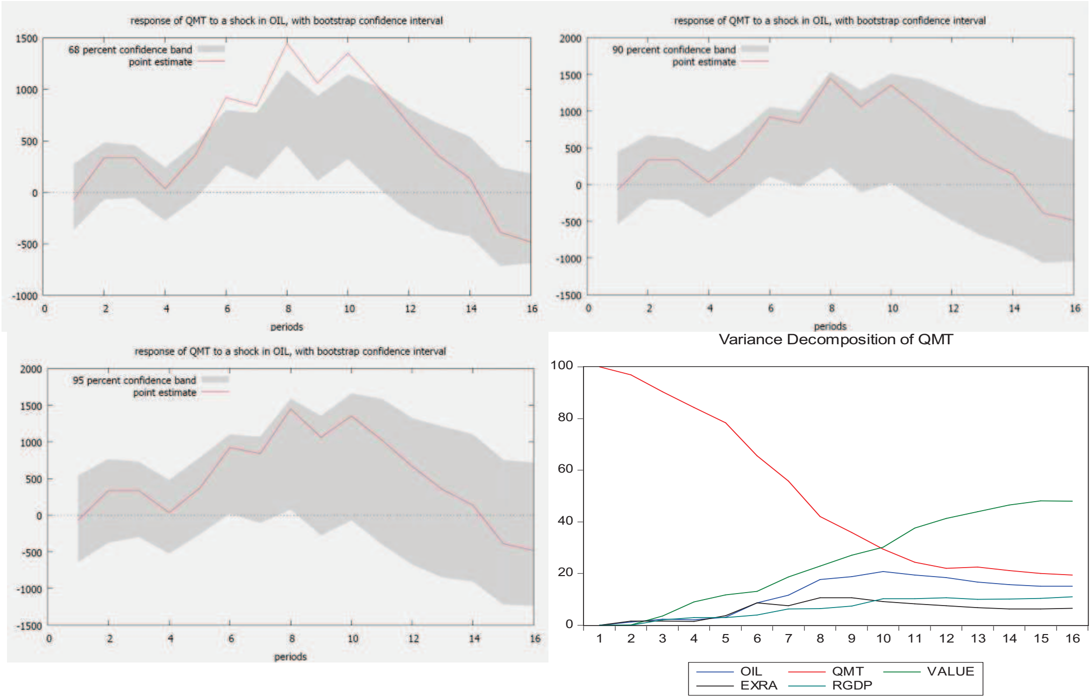
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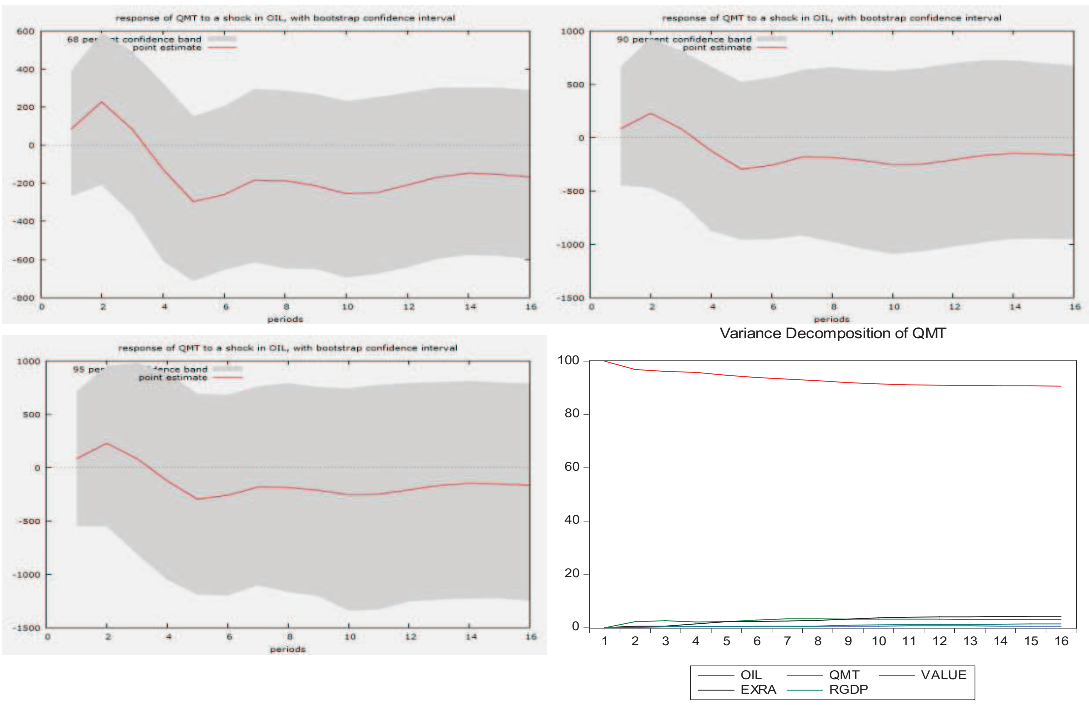
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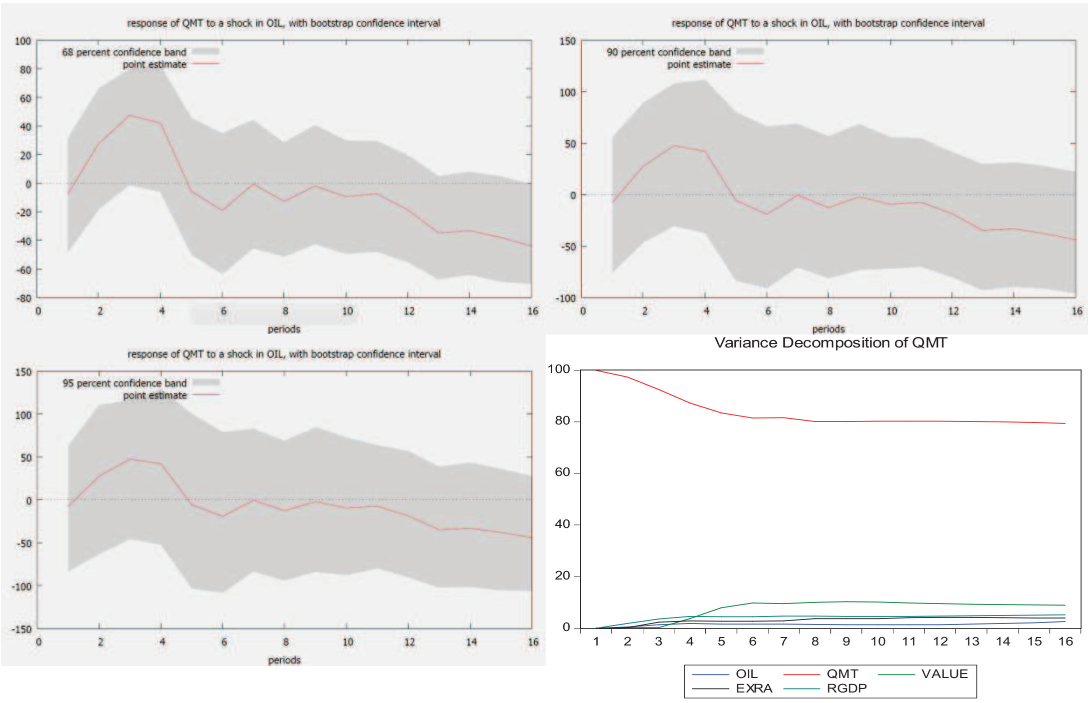
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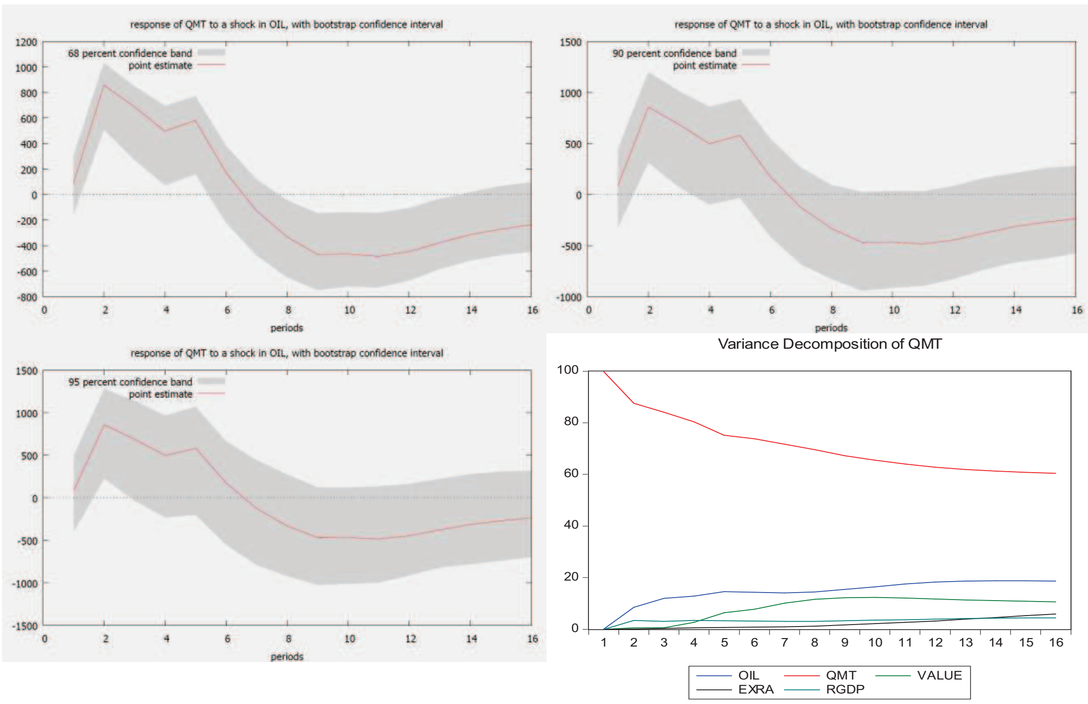
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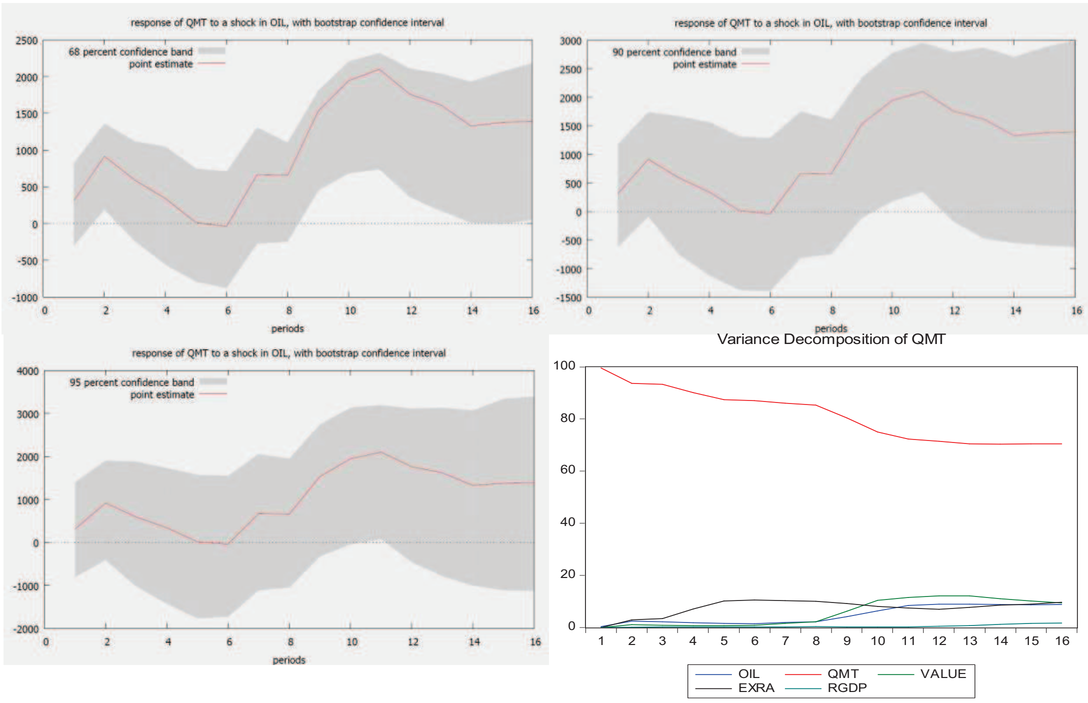
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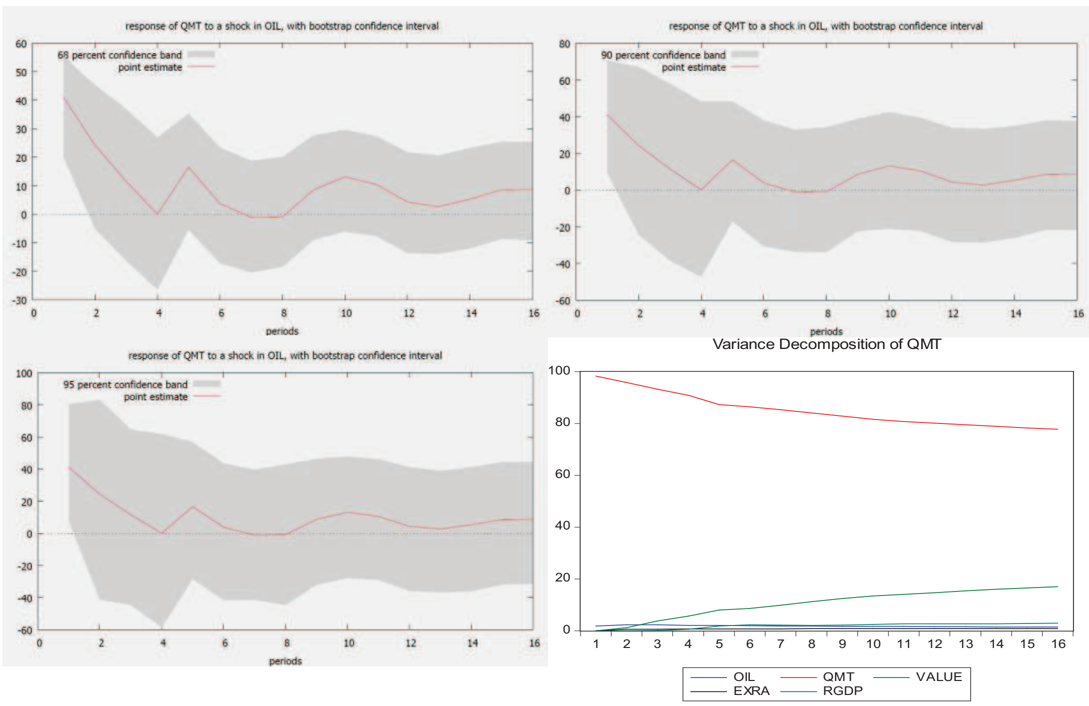
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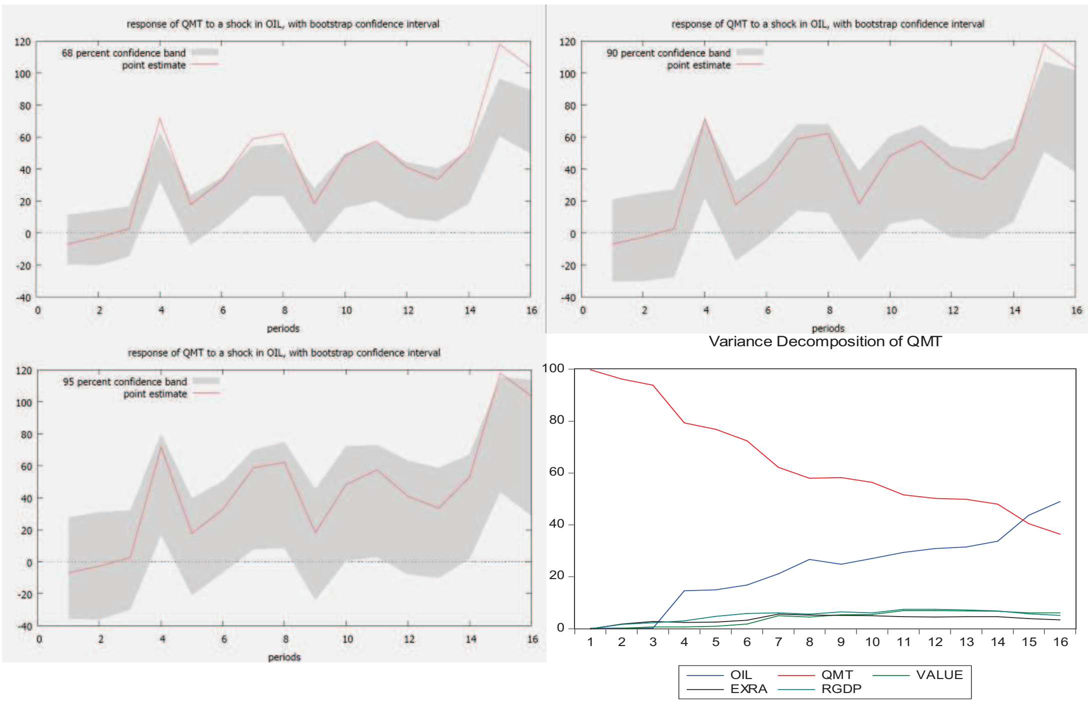
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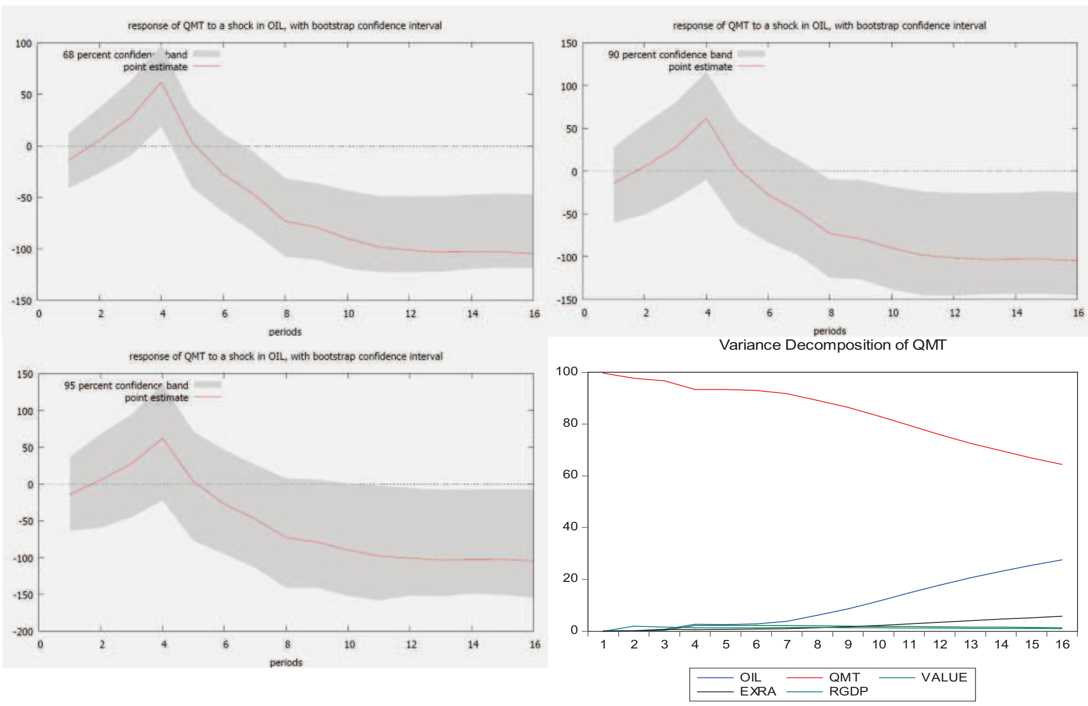
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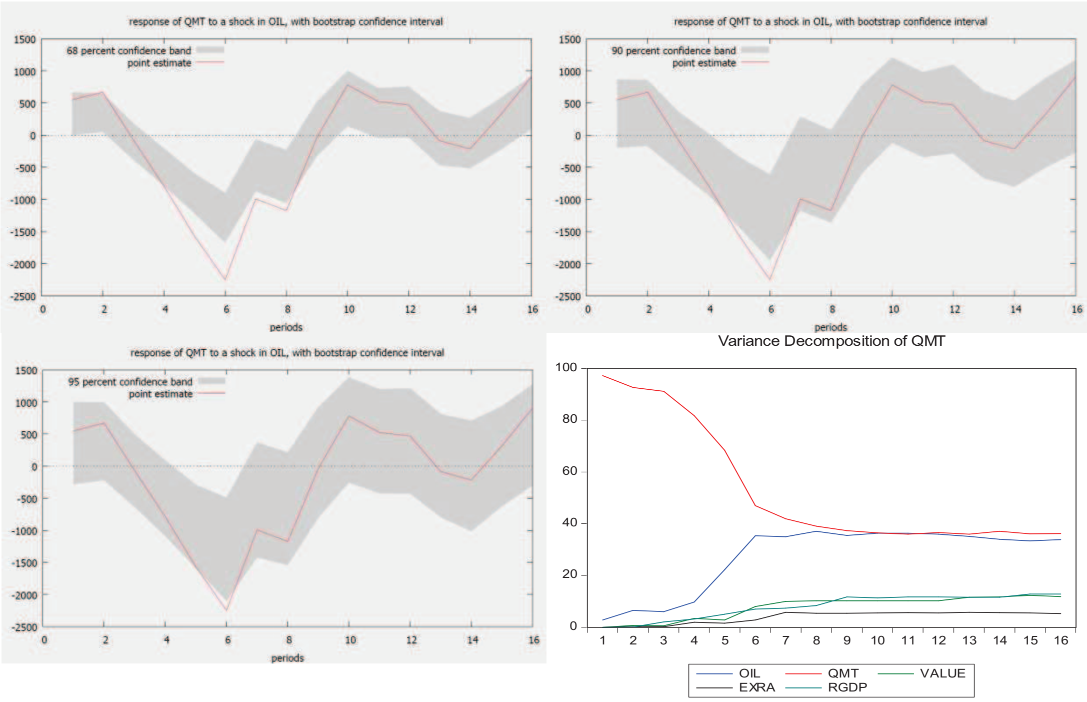
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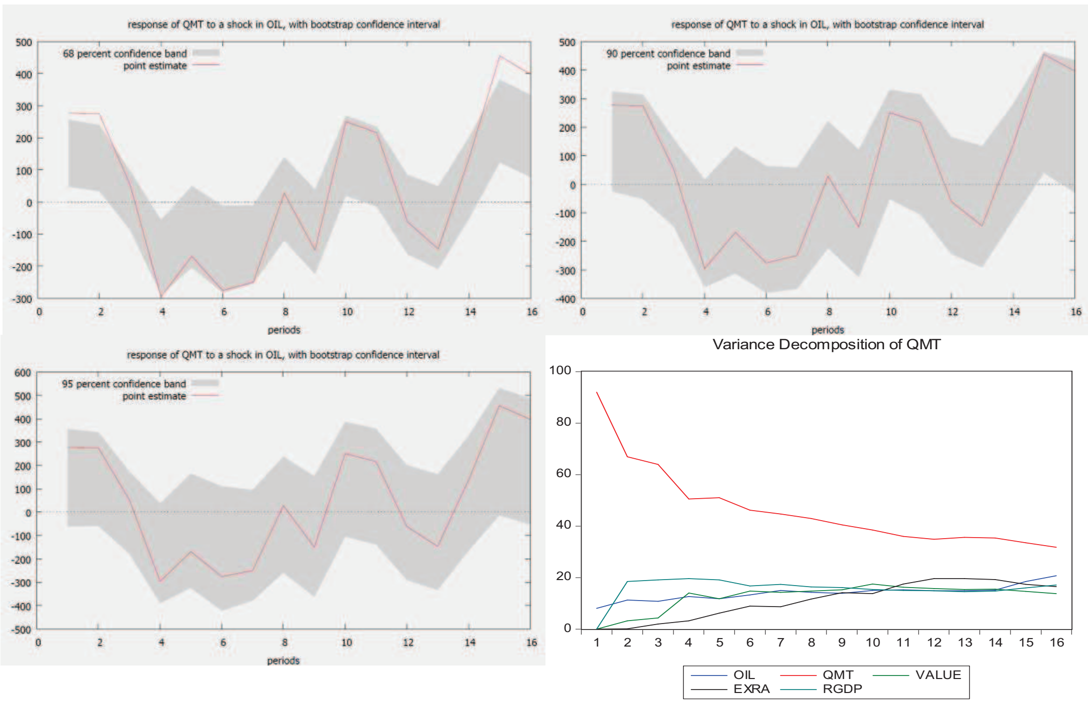
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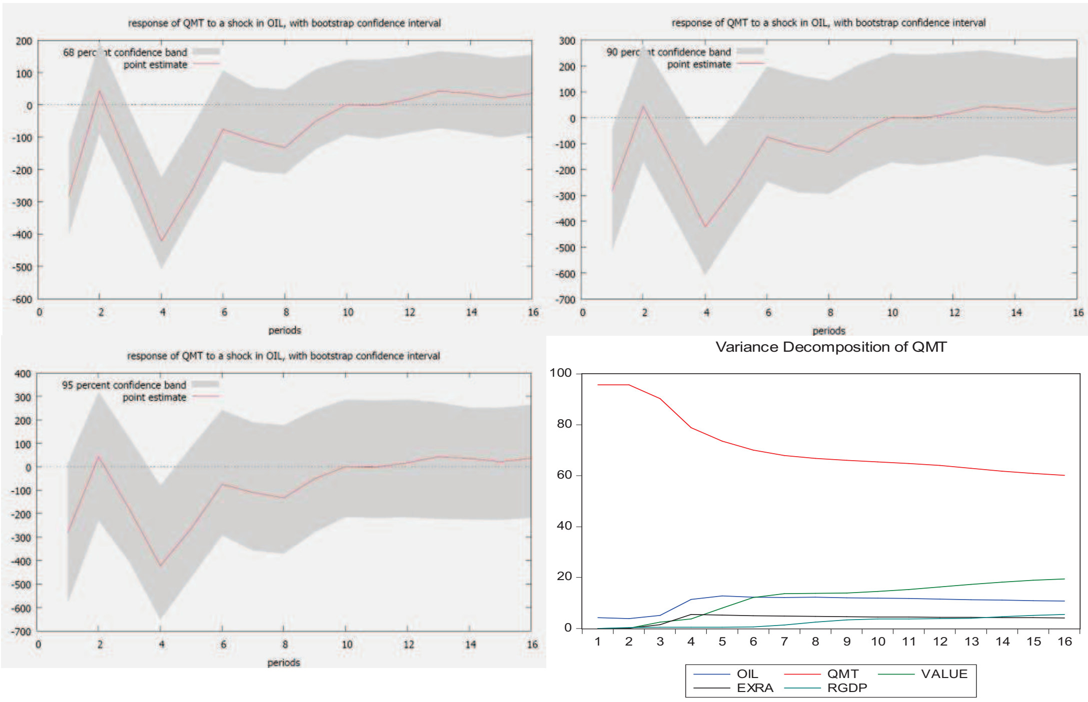
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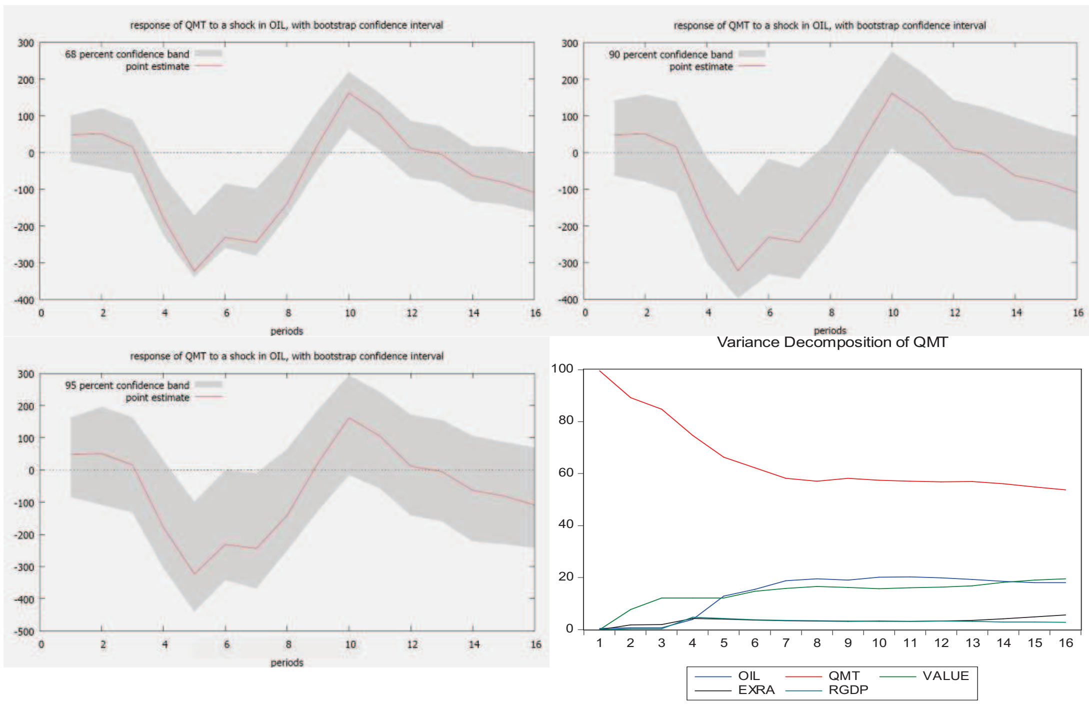
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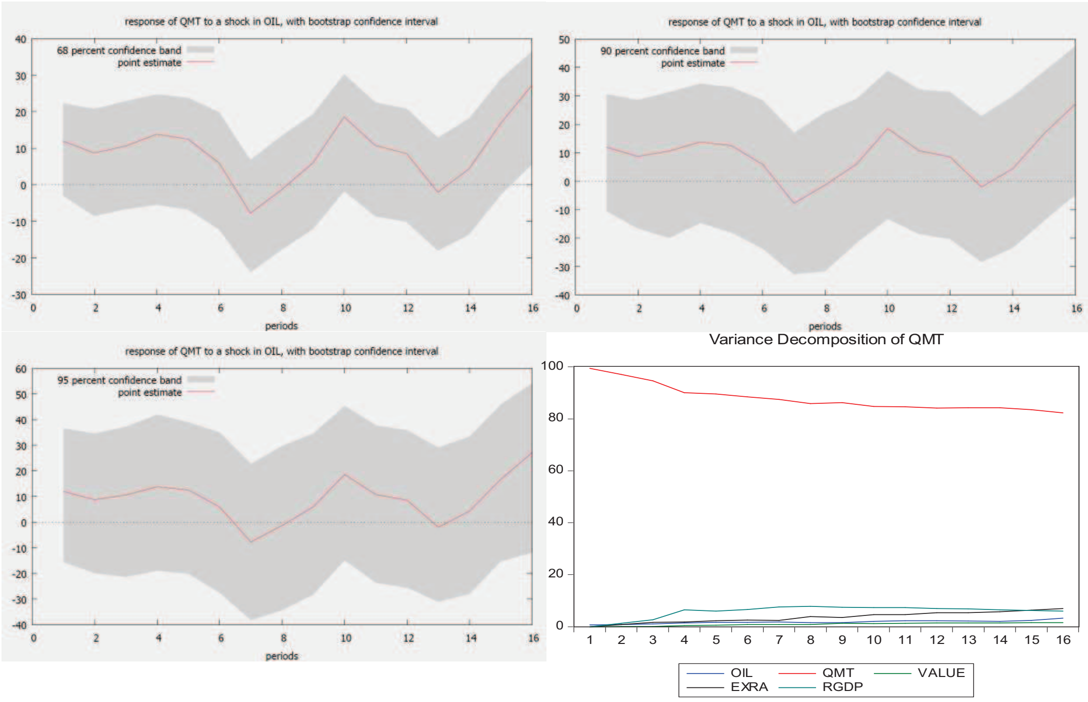
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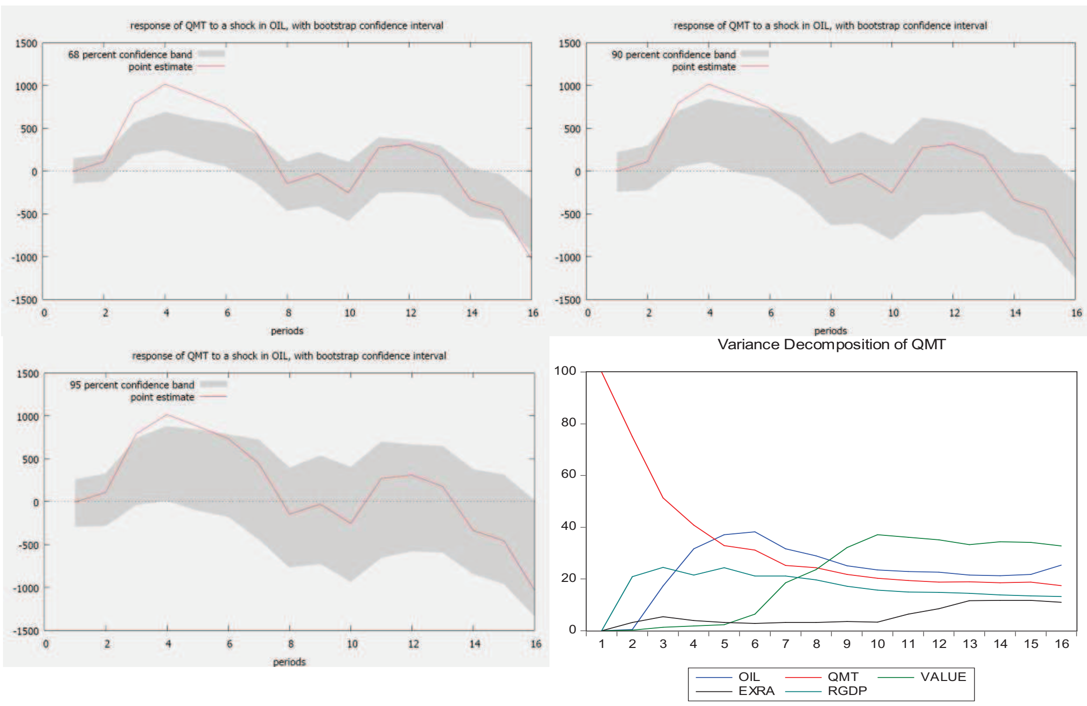
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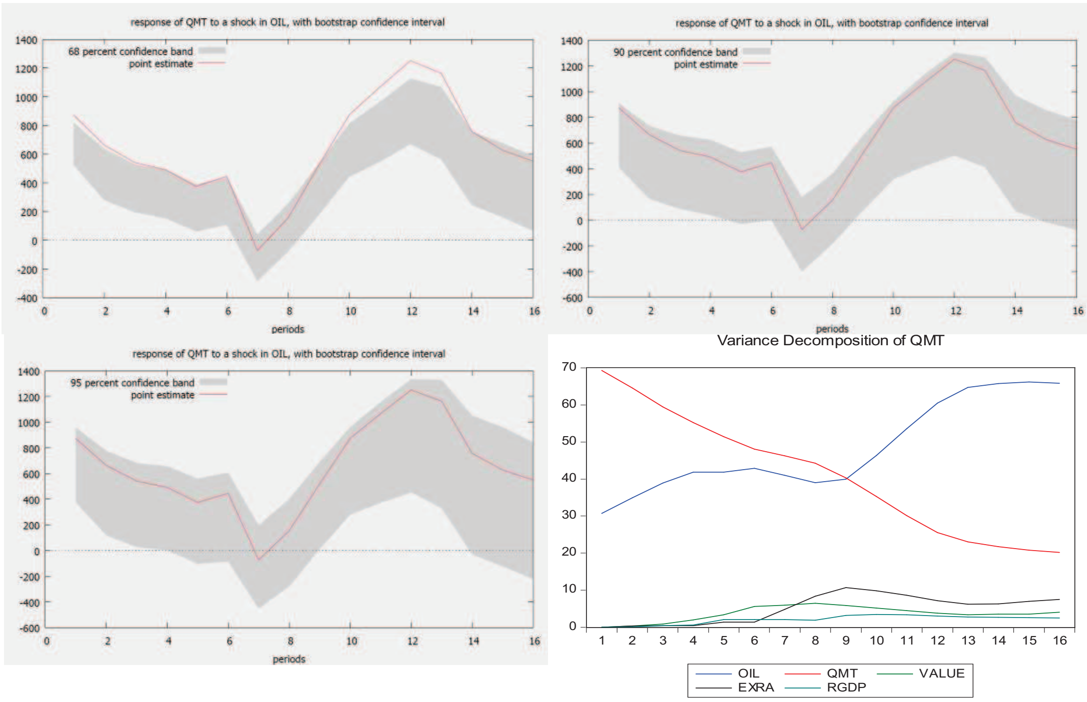
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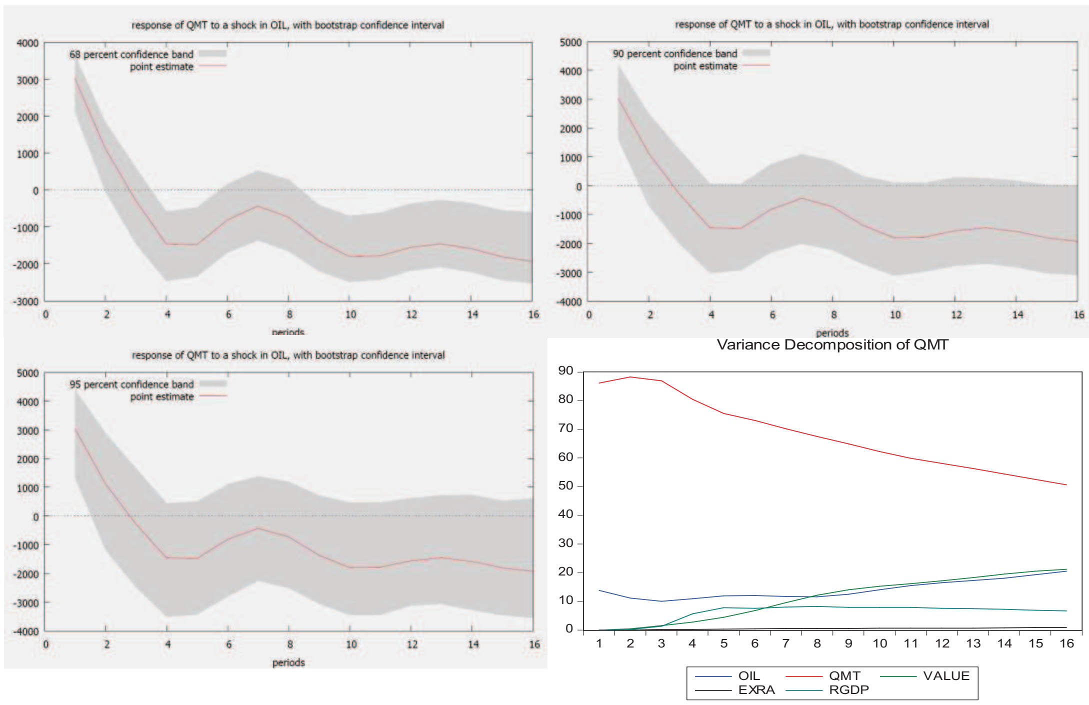
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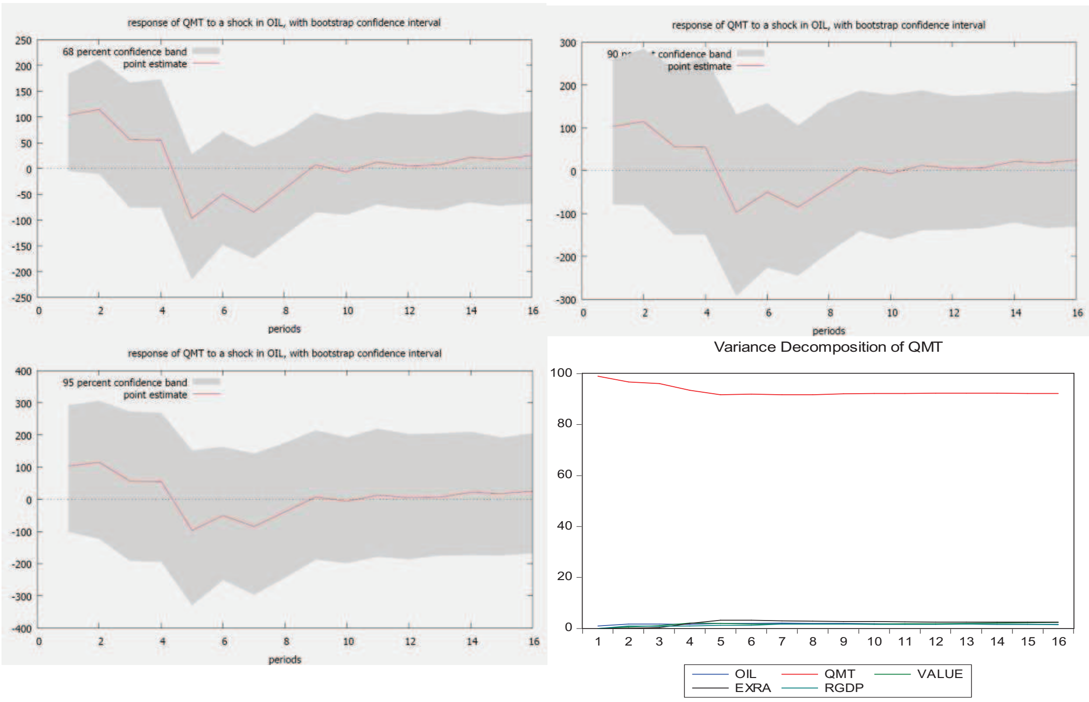
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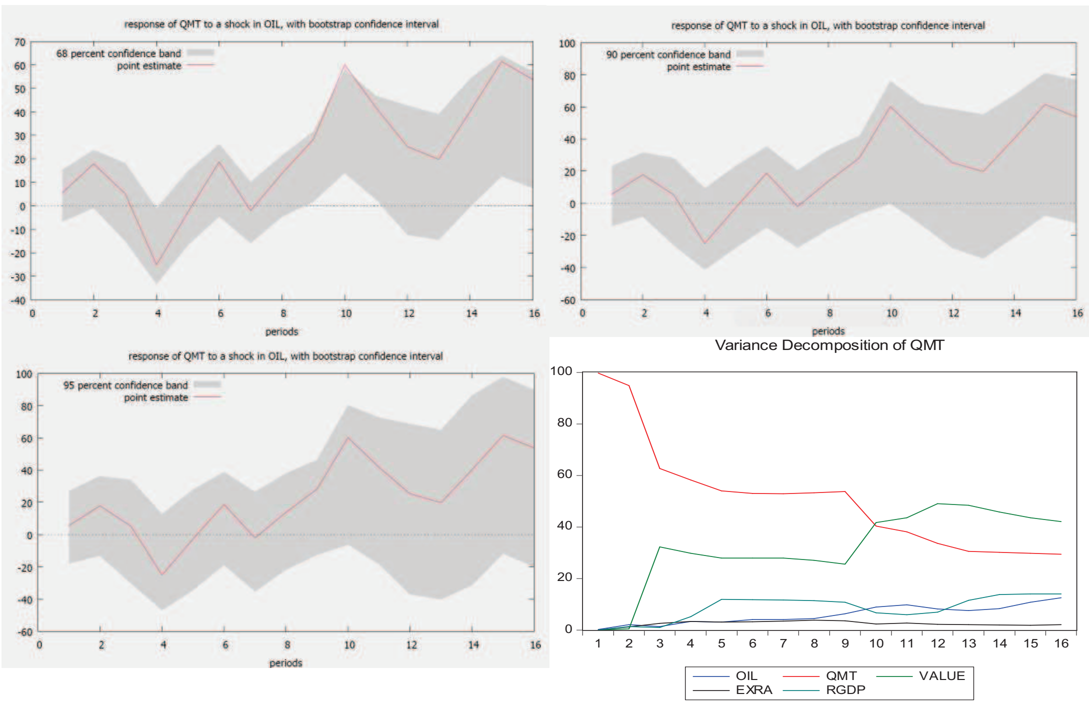
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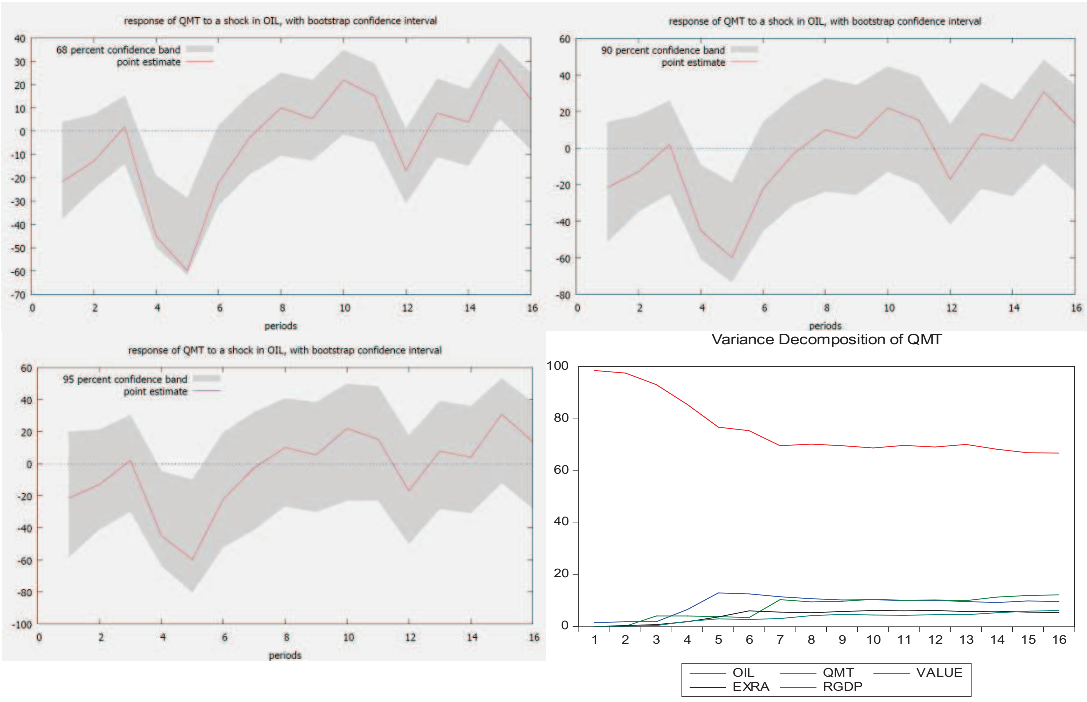
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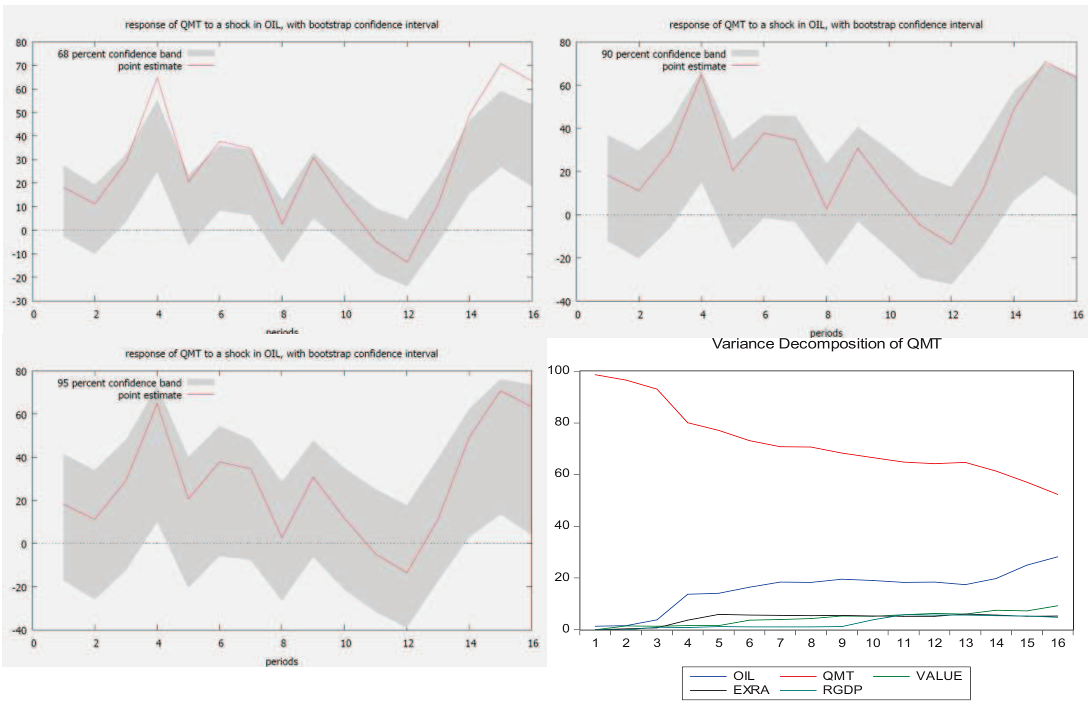
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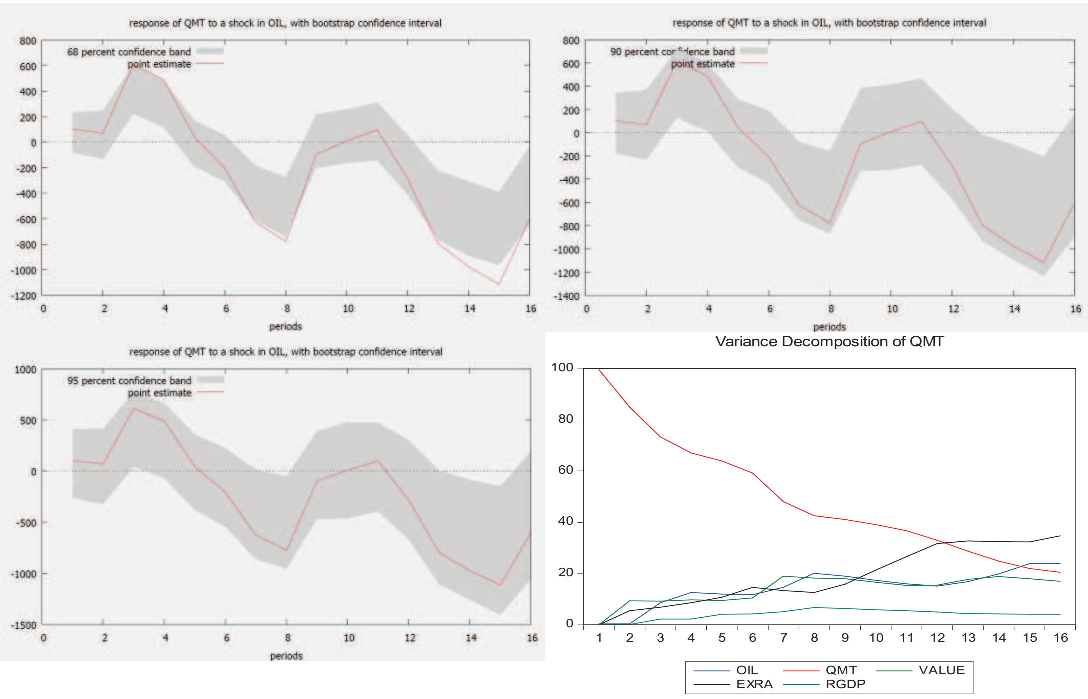
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point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
90 percent confidence band
point estimate
periods
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periods
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QMT
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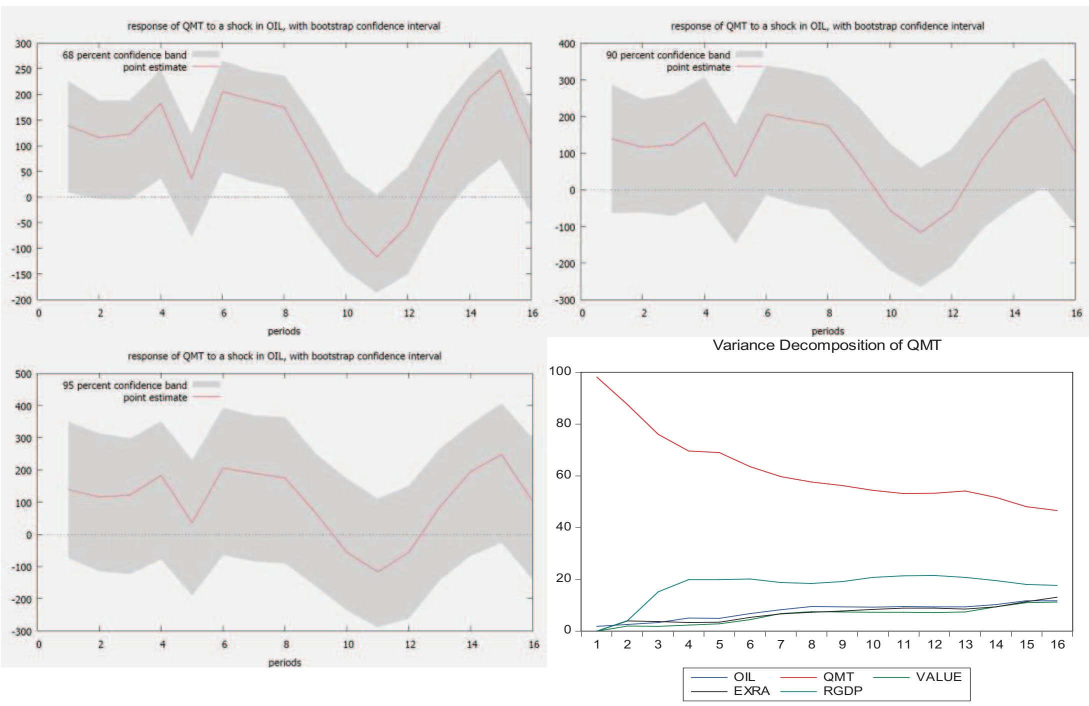
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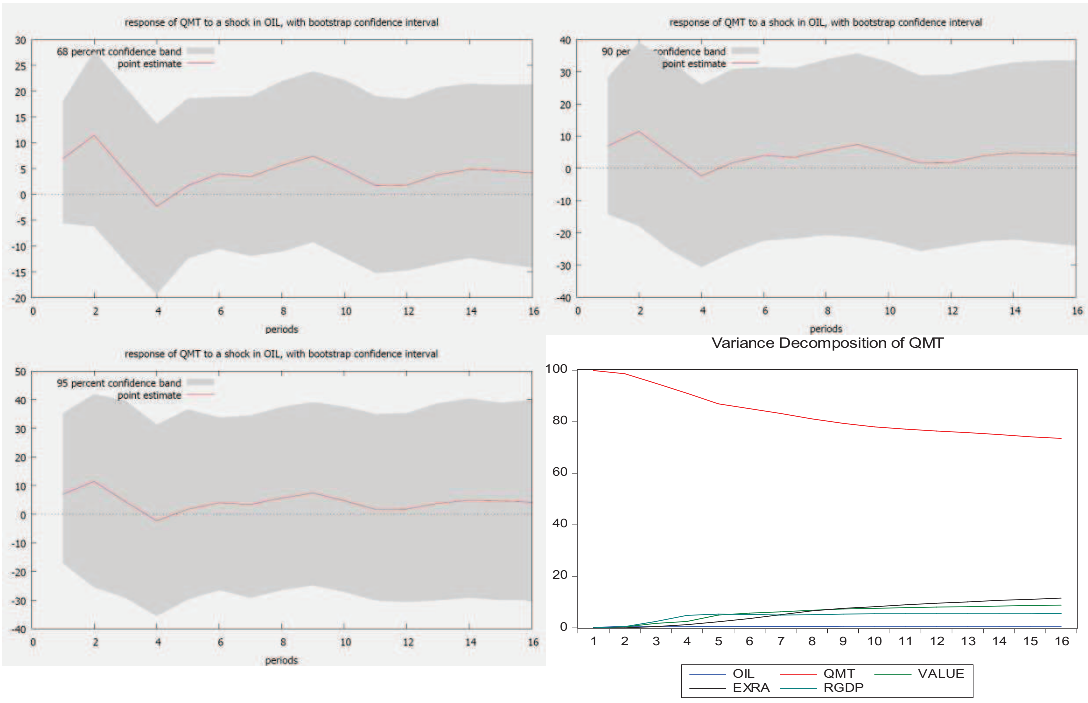
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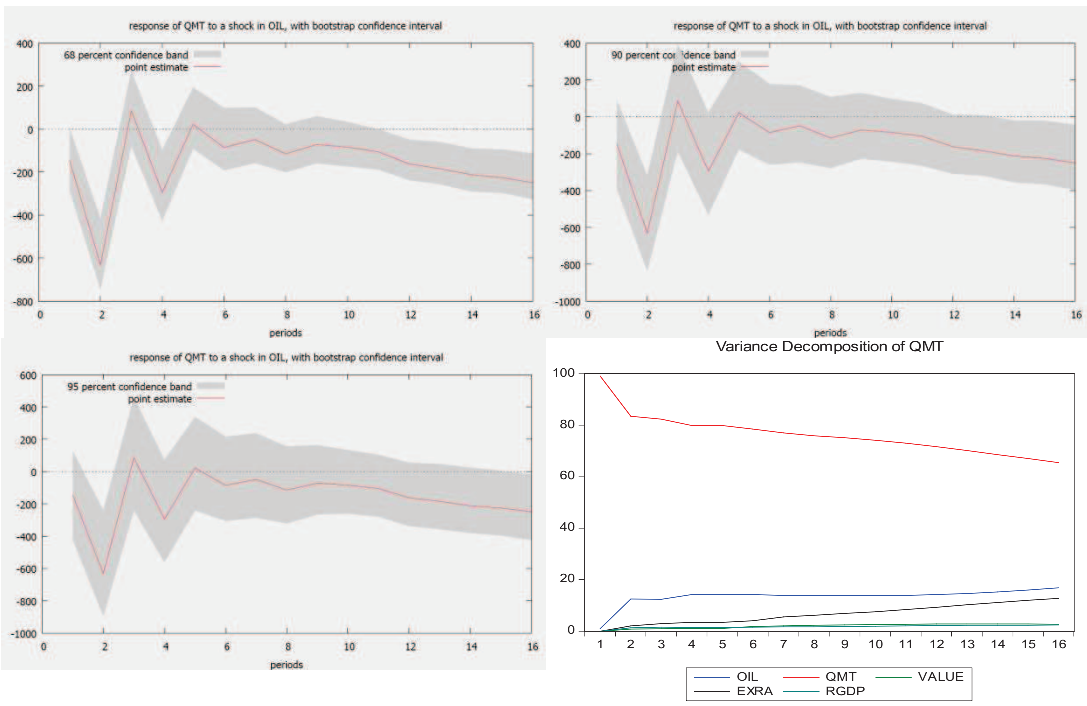
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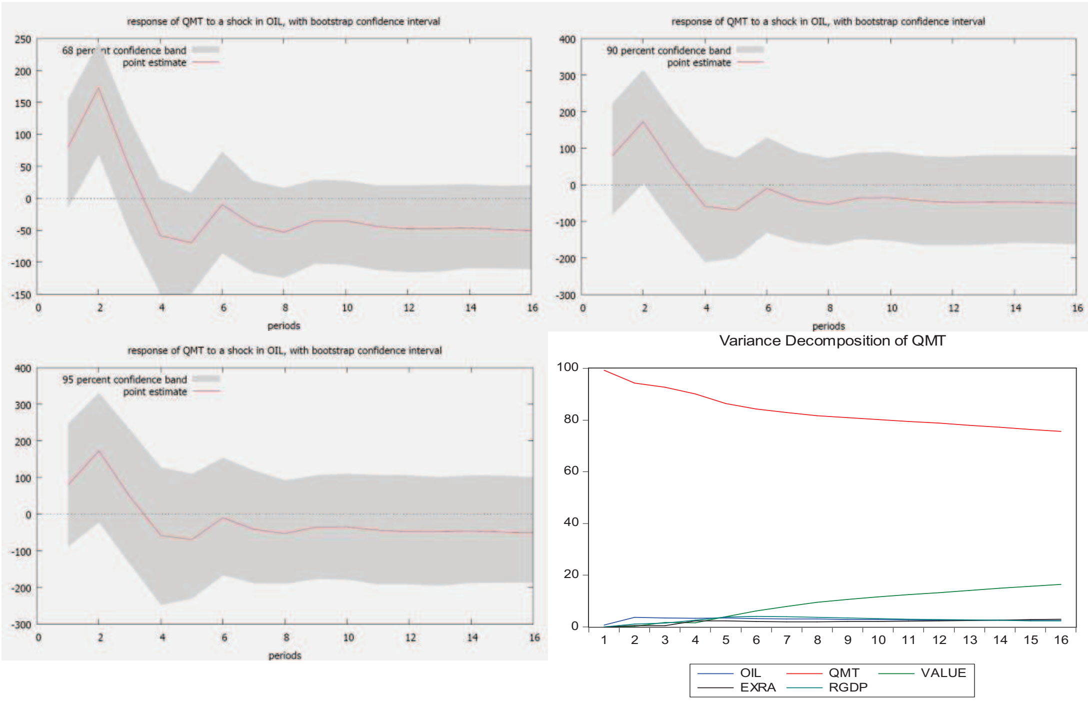
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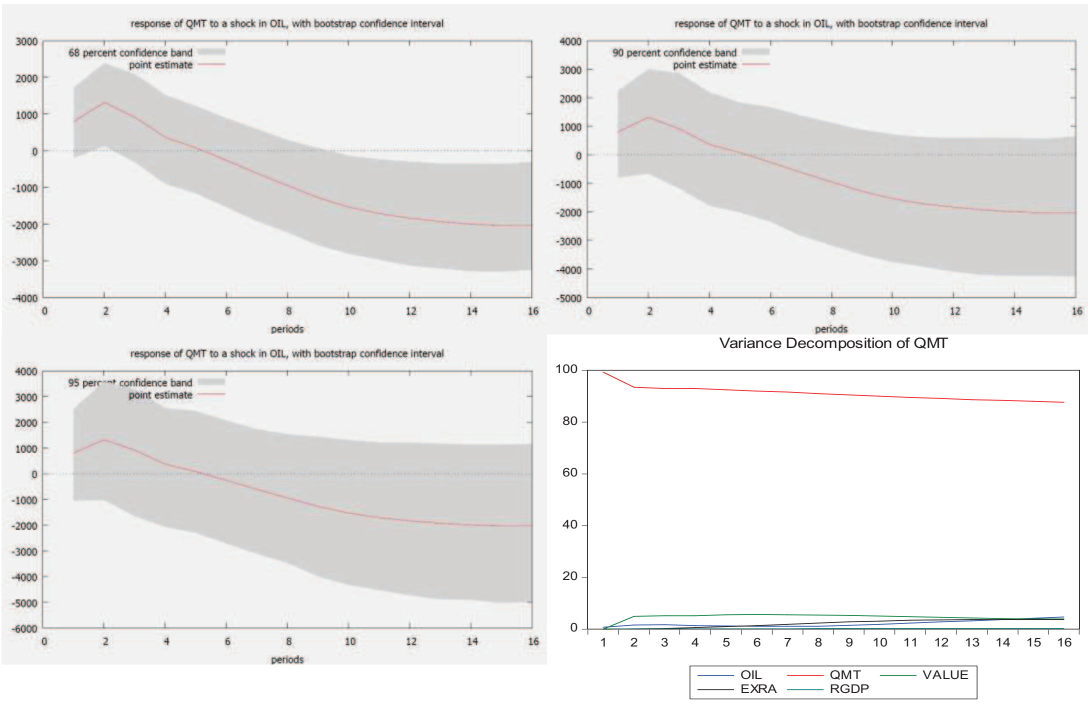
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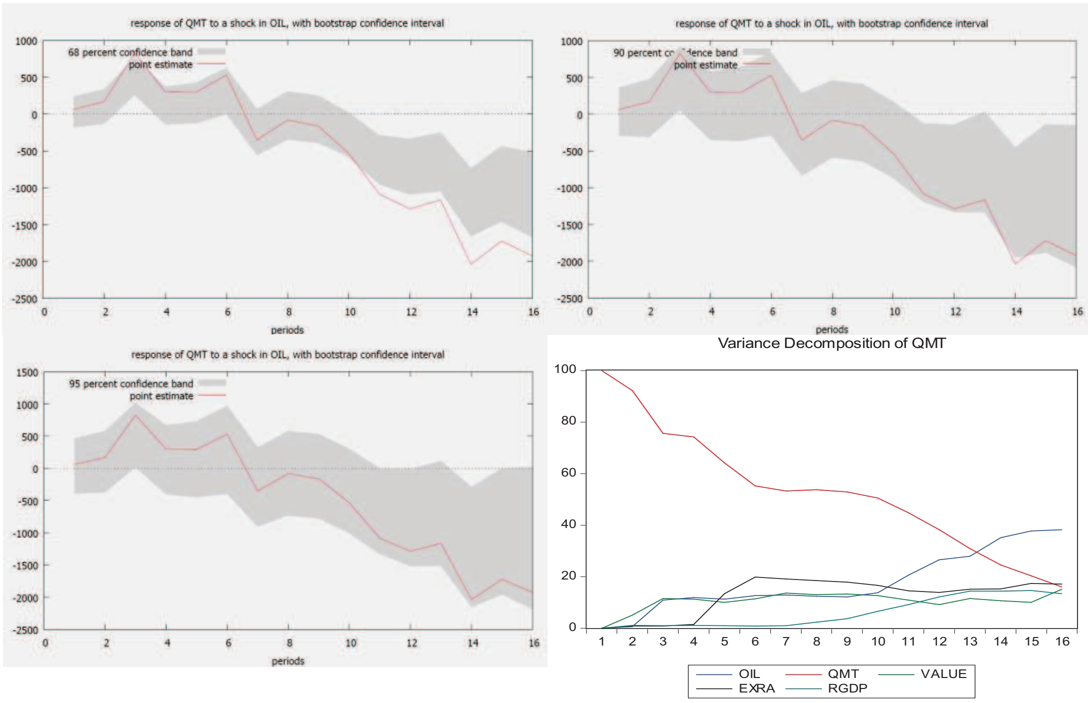
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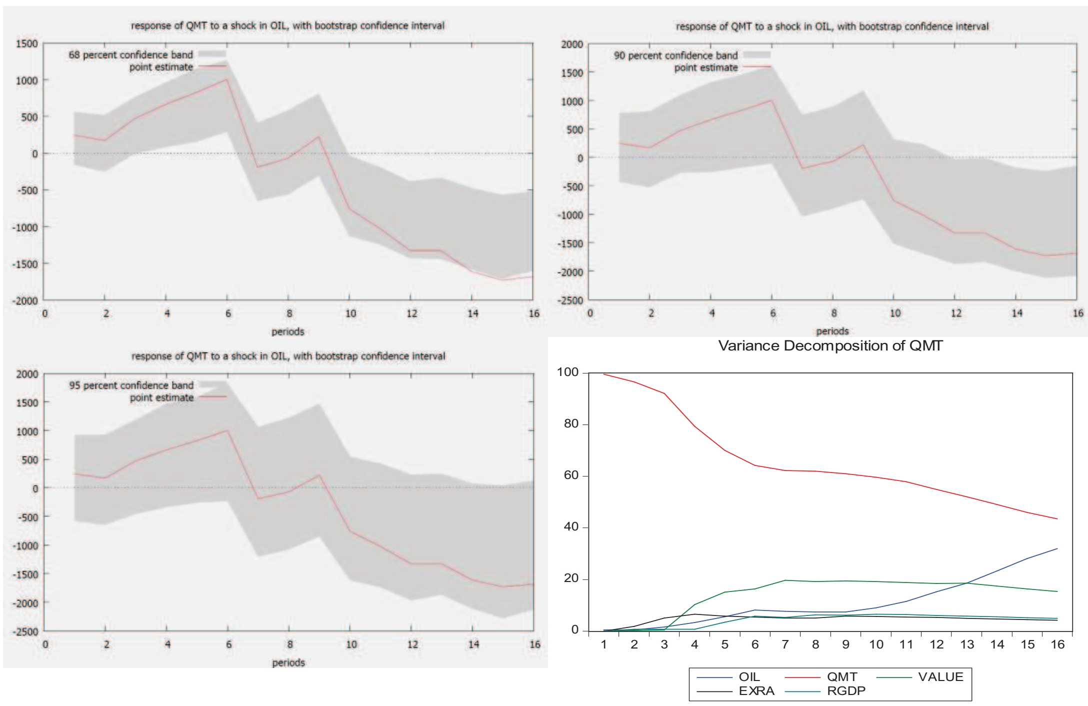
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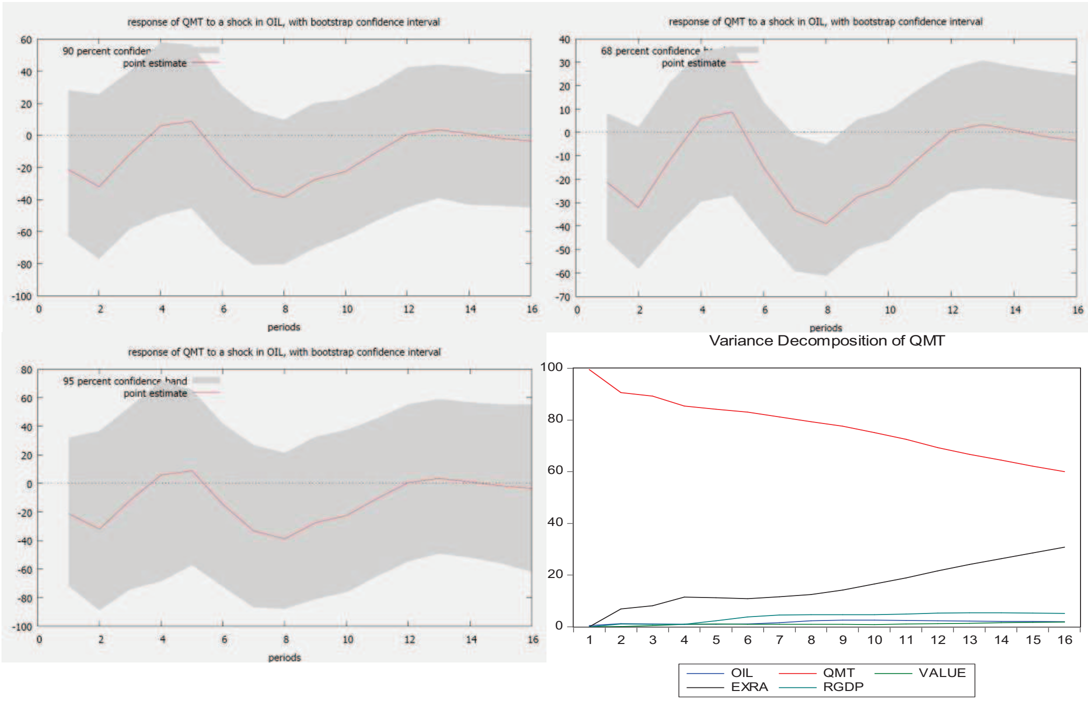
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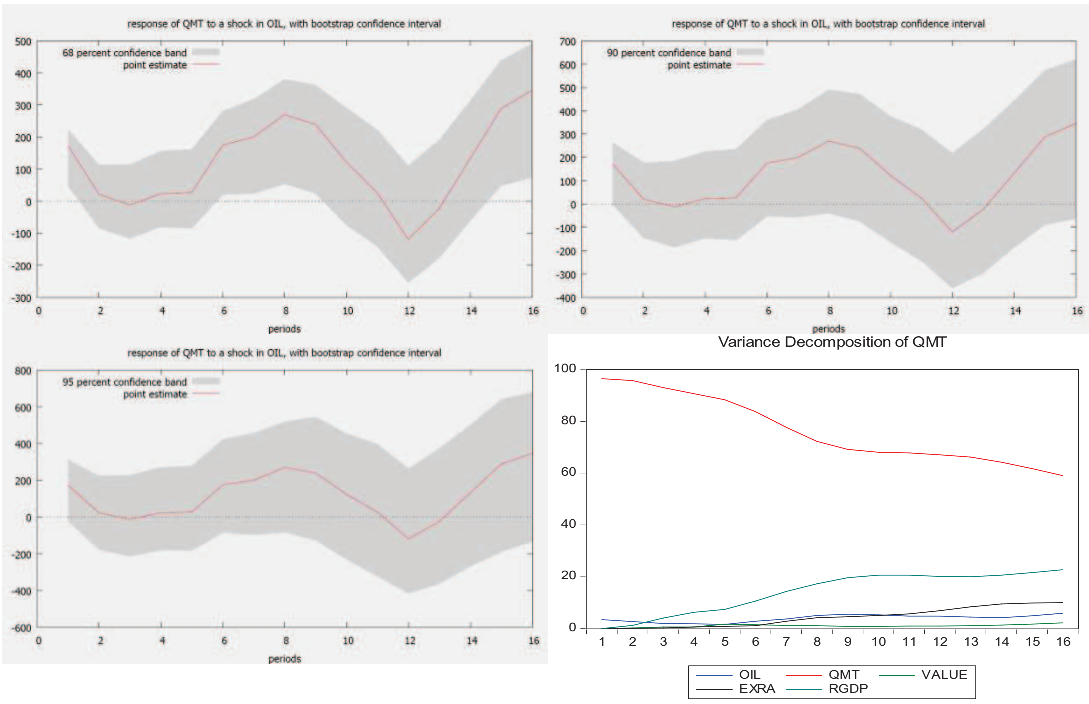
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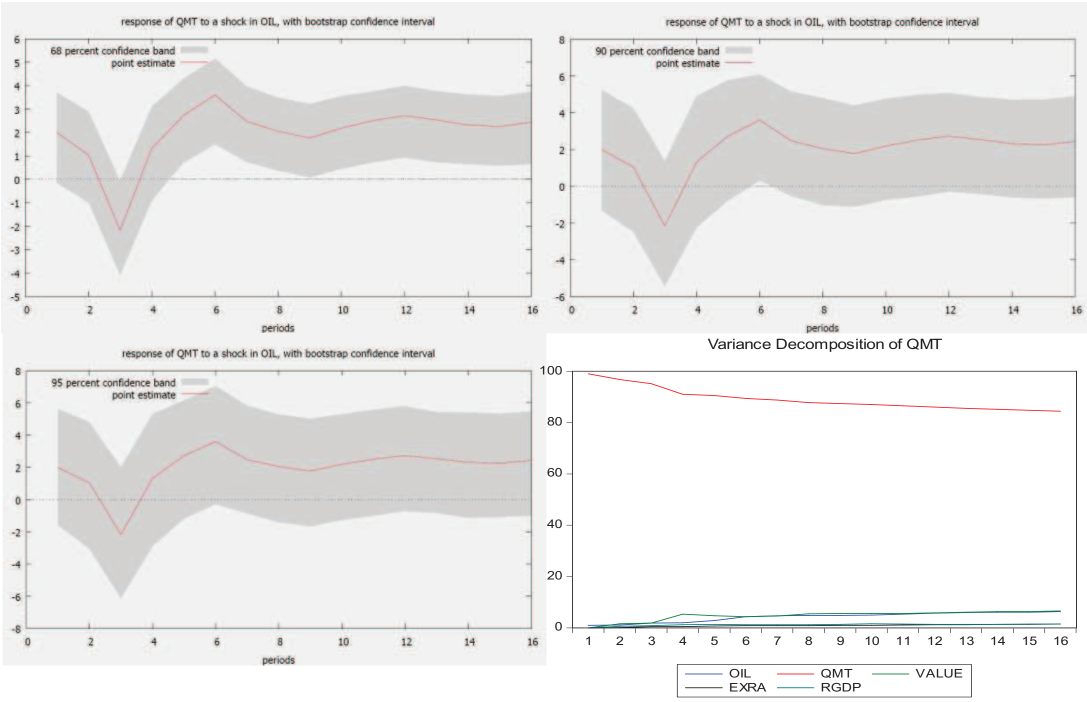
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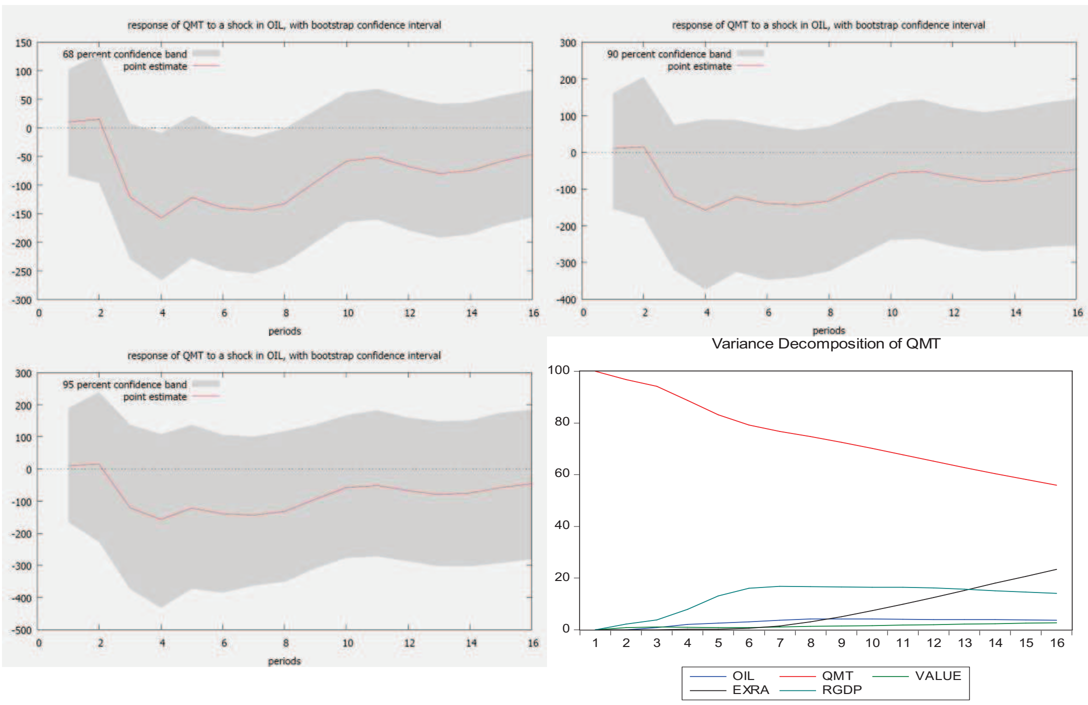
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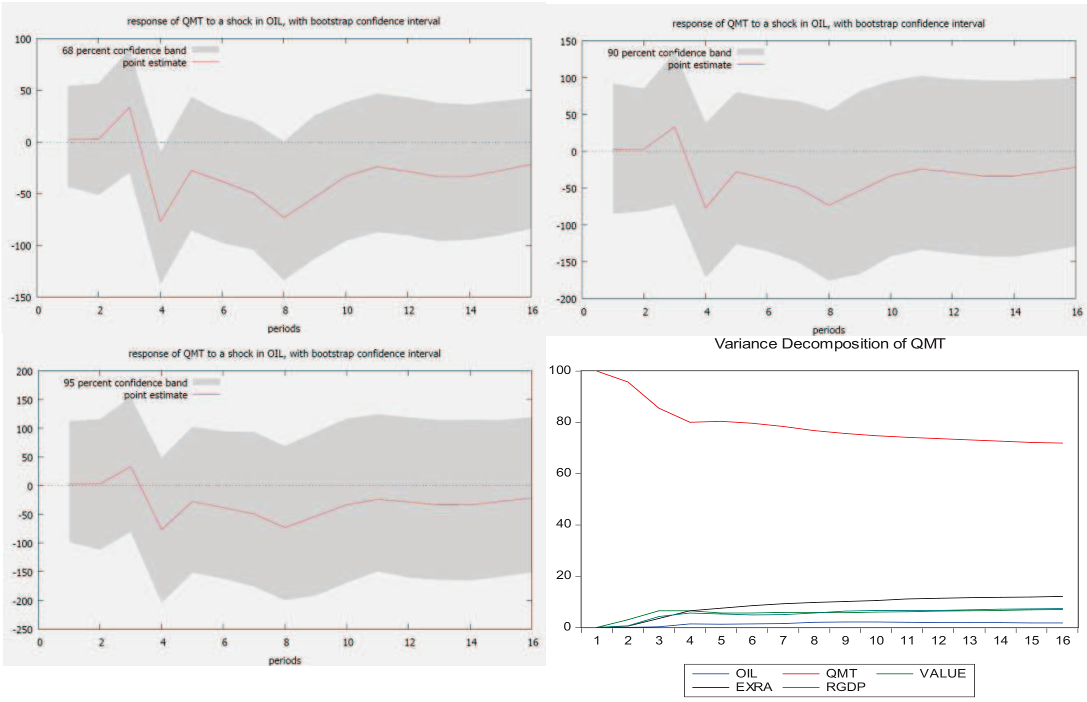

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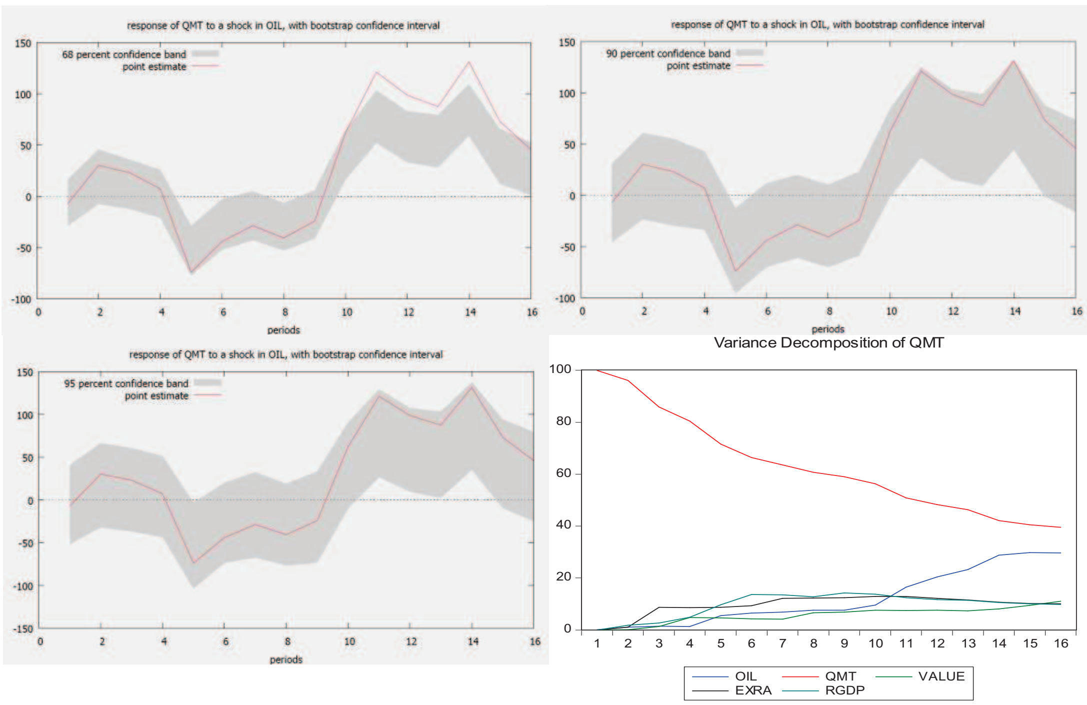

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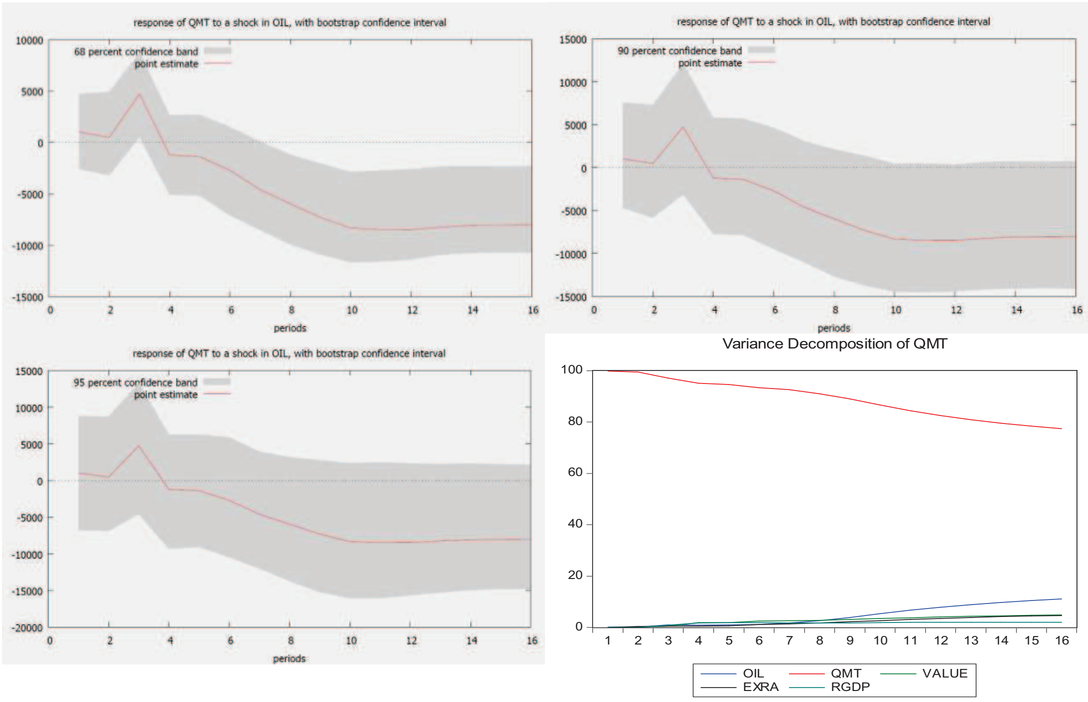
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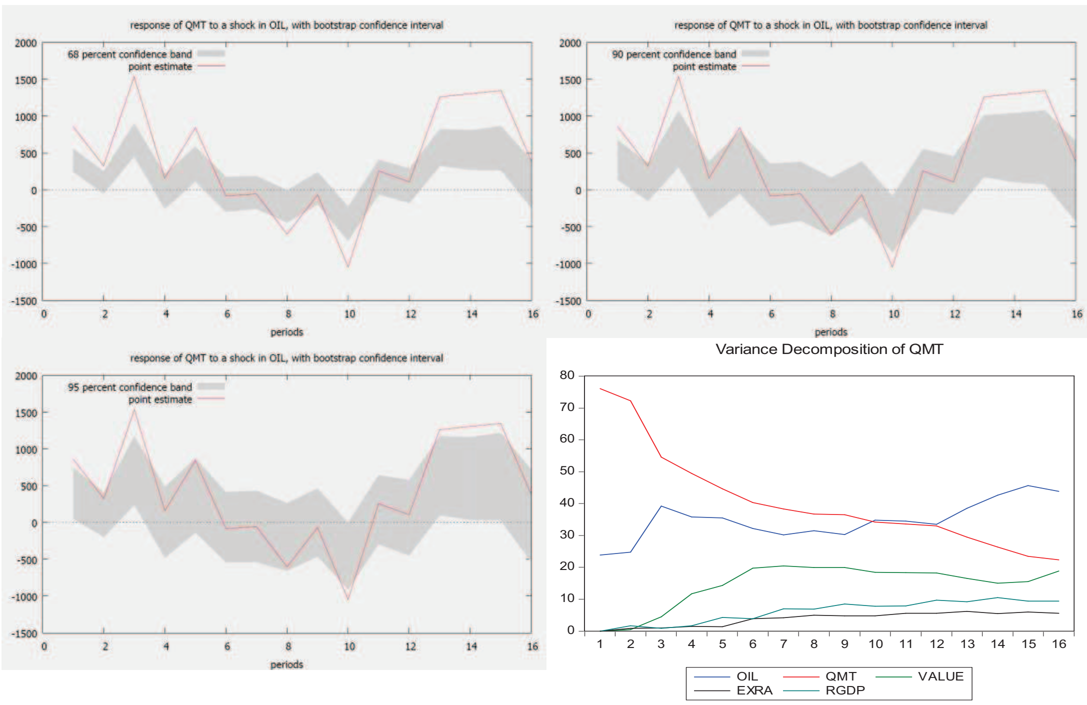
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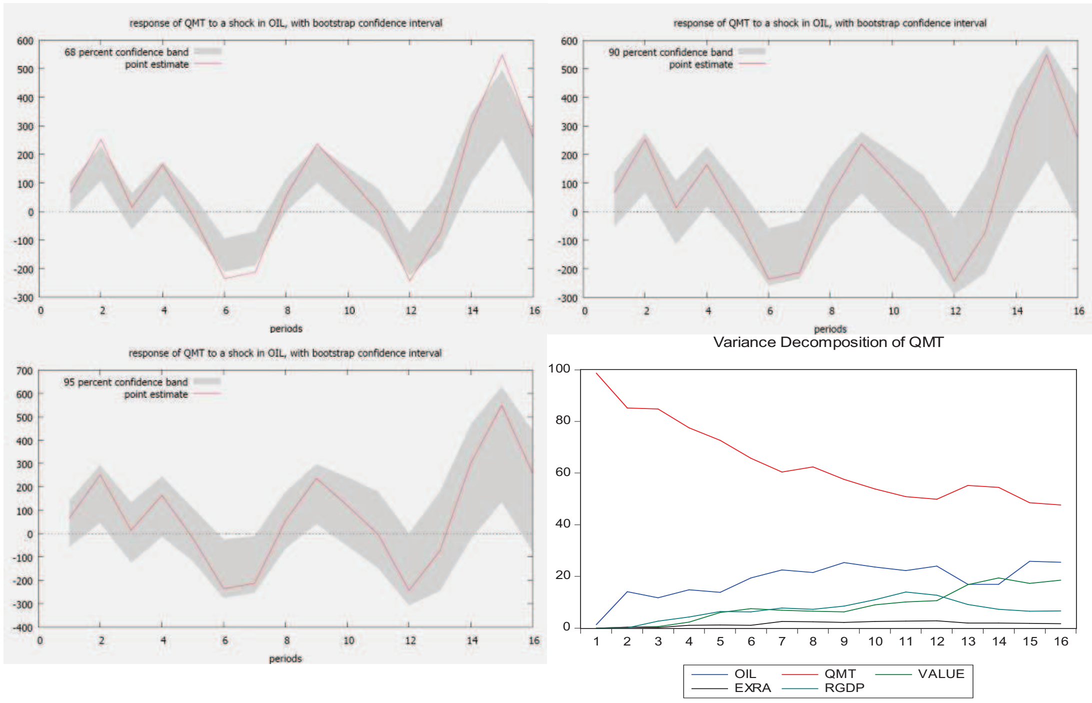
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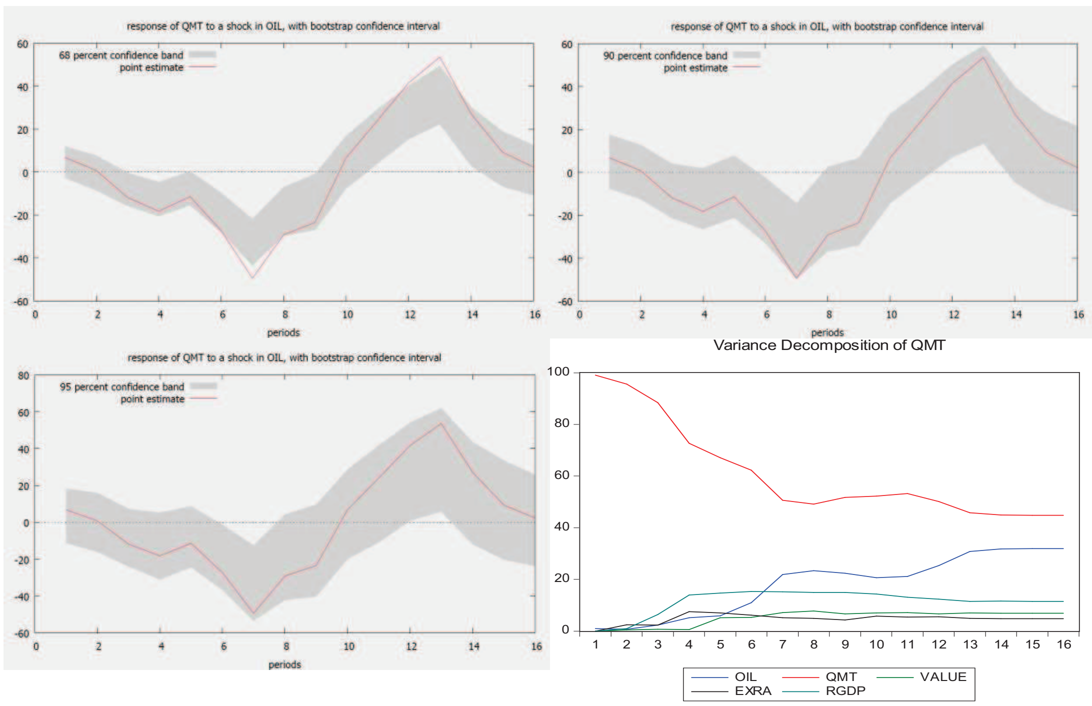
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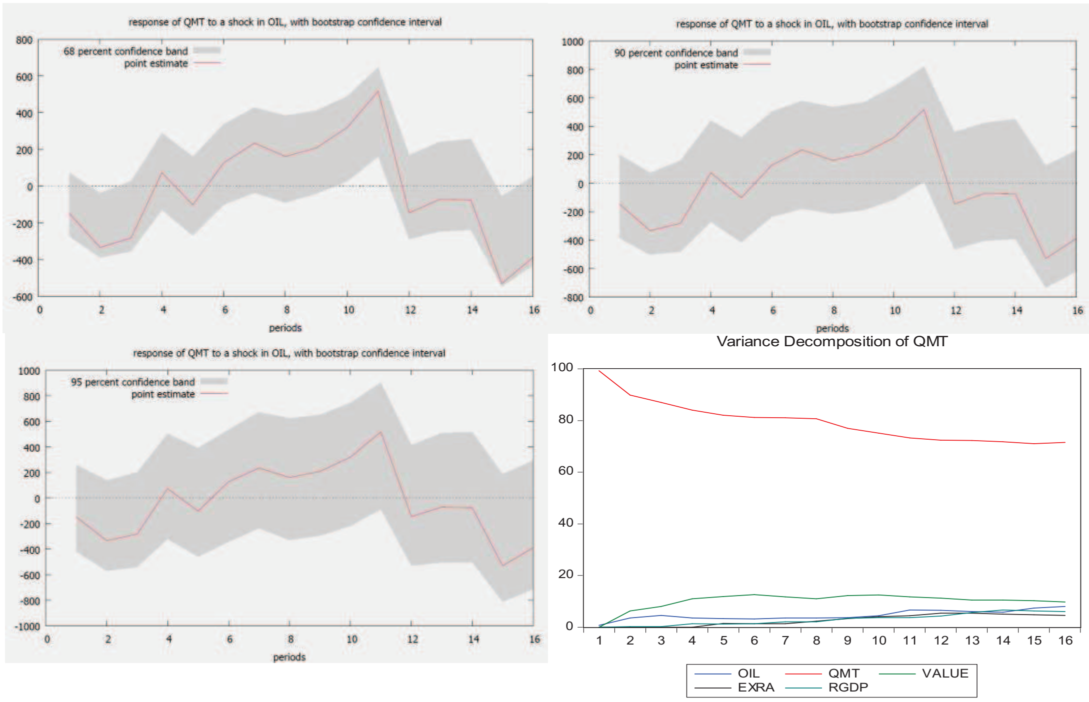
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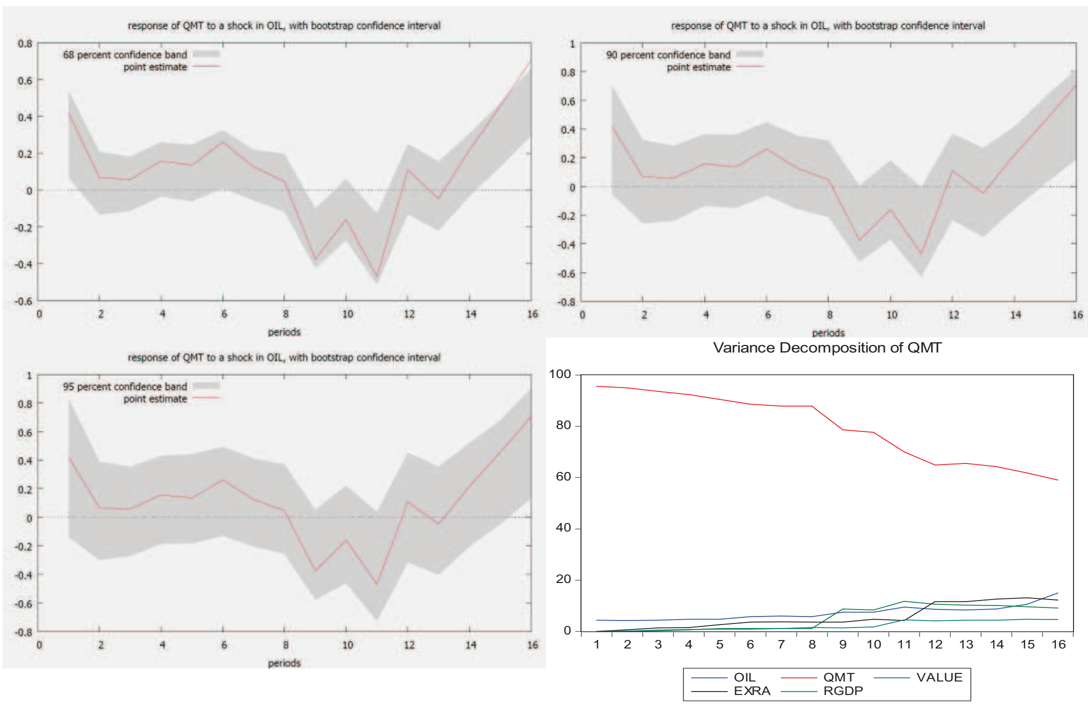
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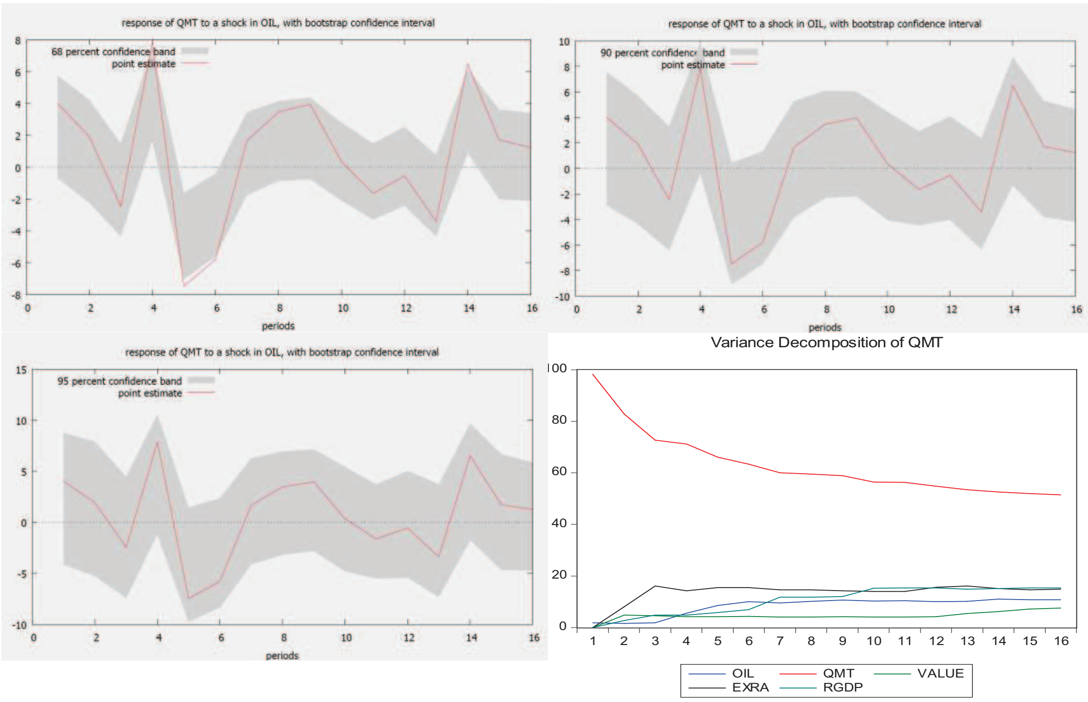
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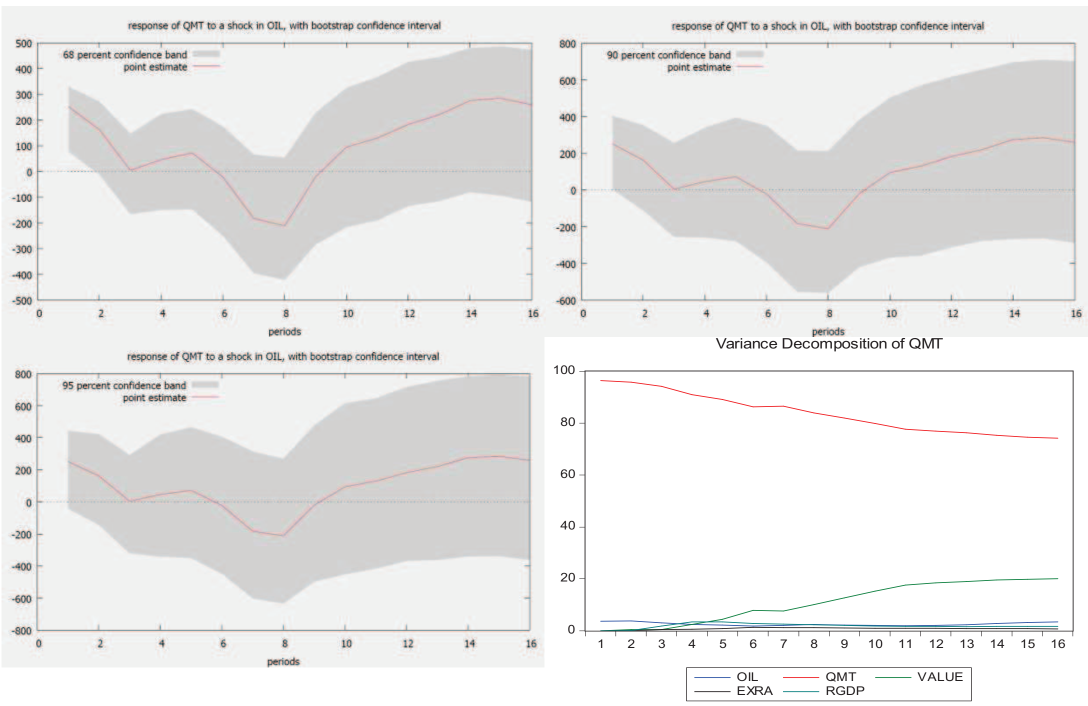
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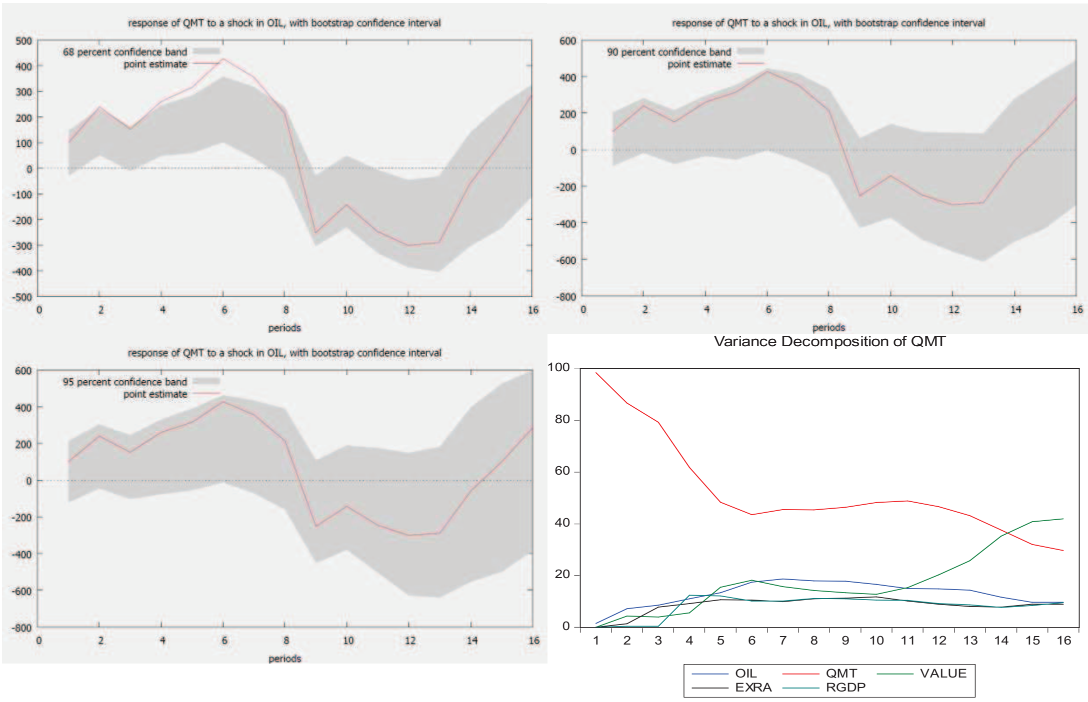
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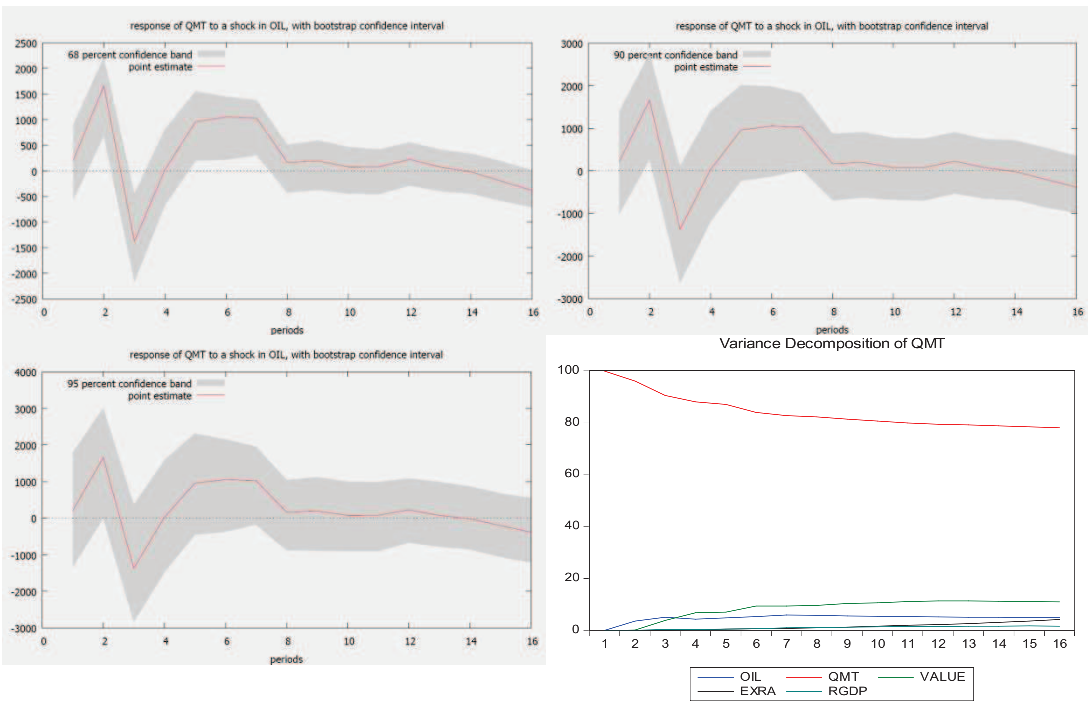
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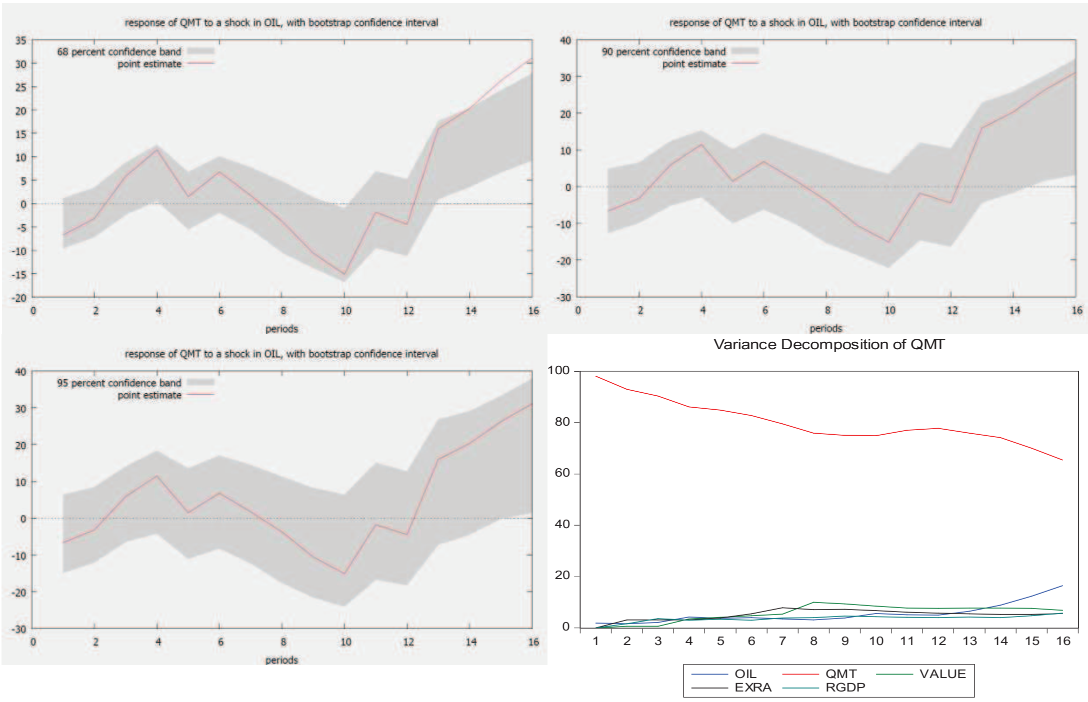
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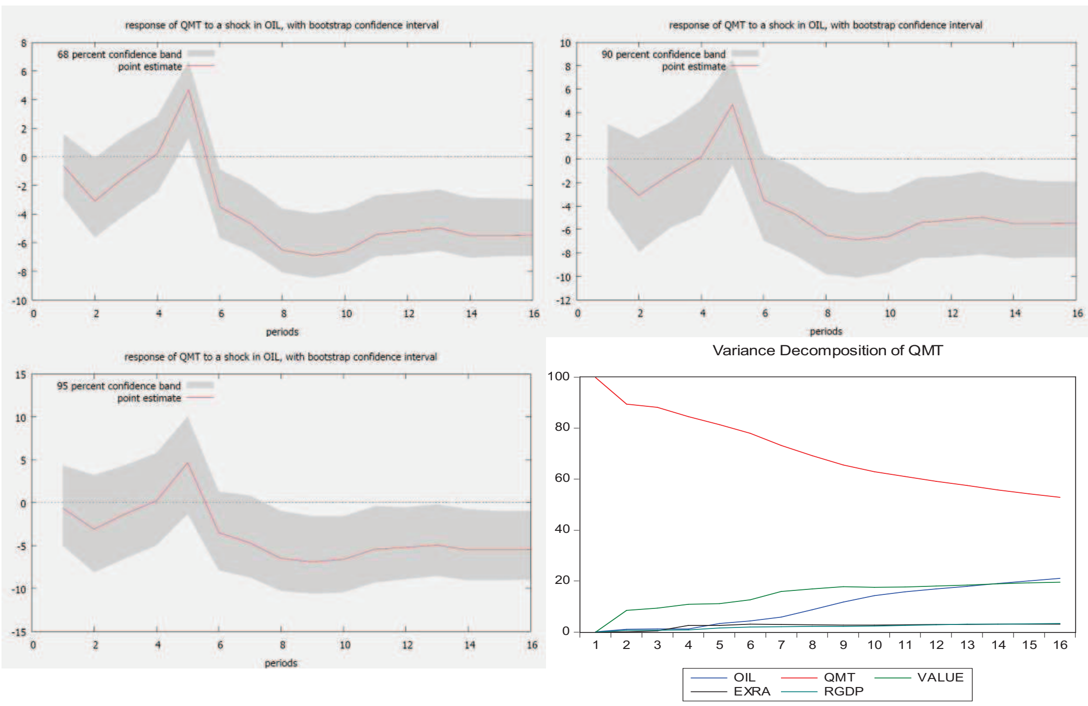
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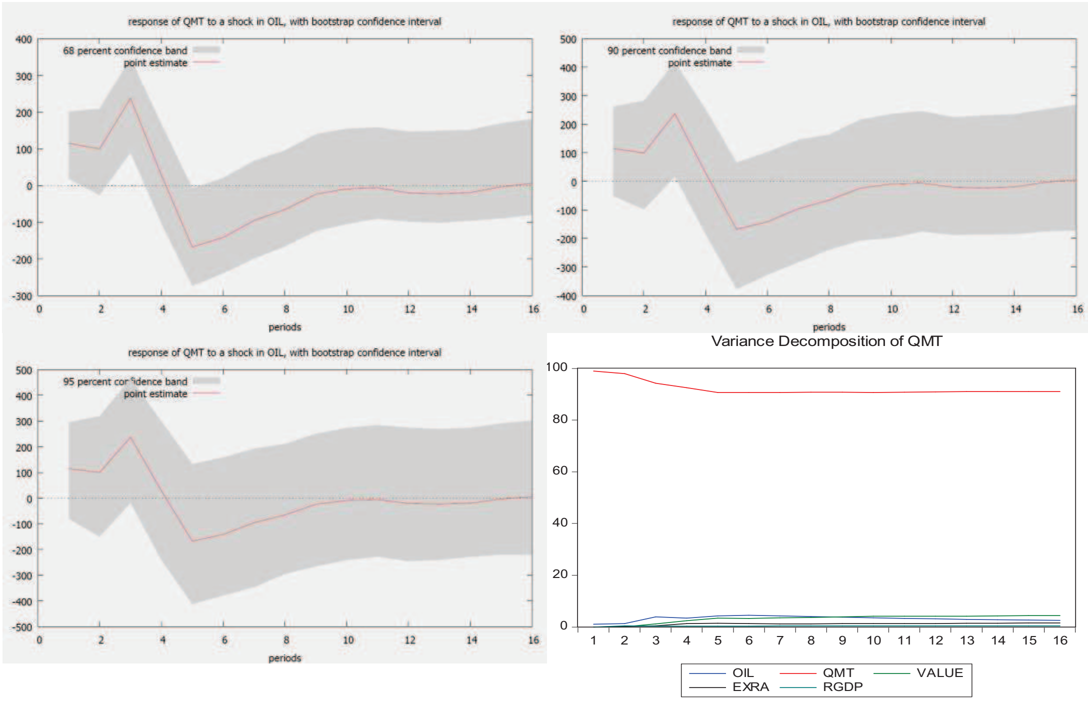
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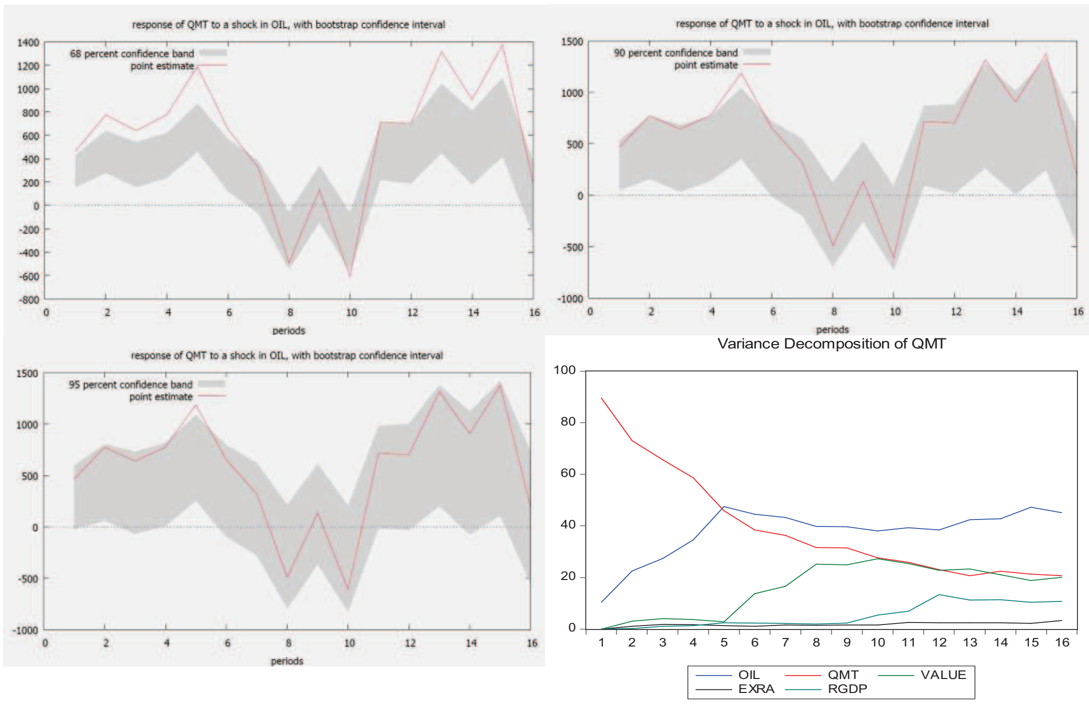
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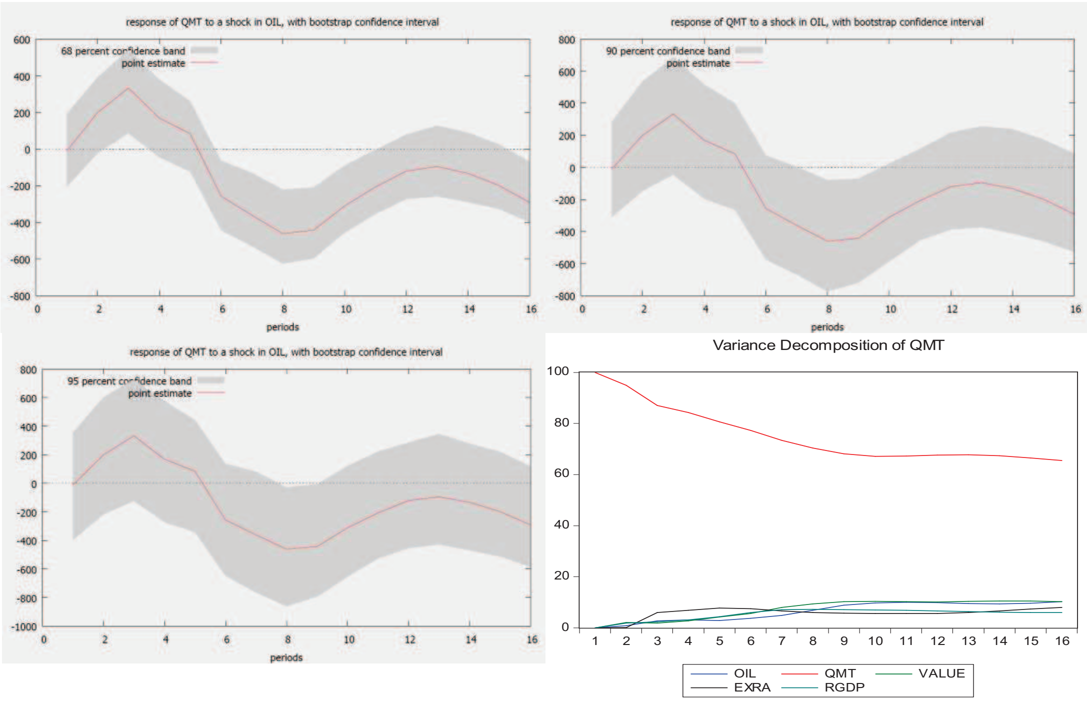
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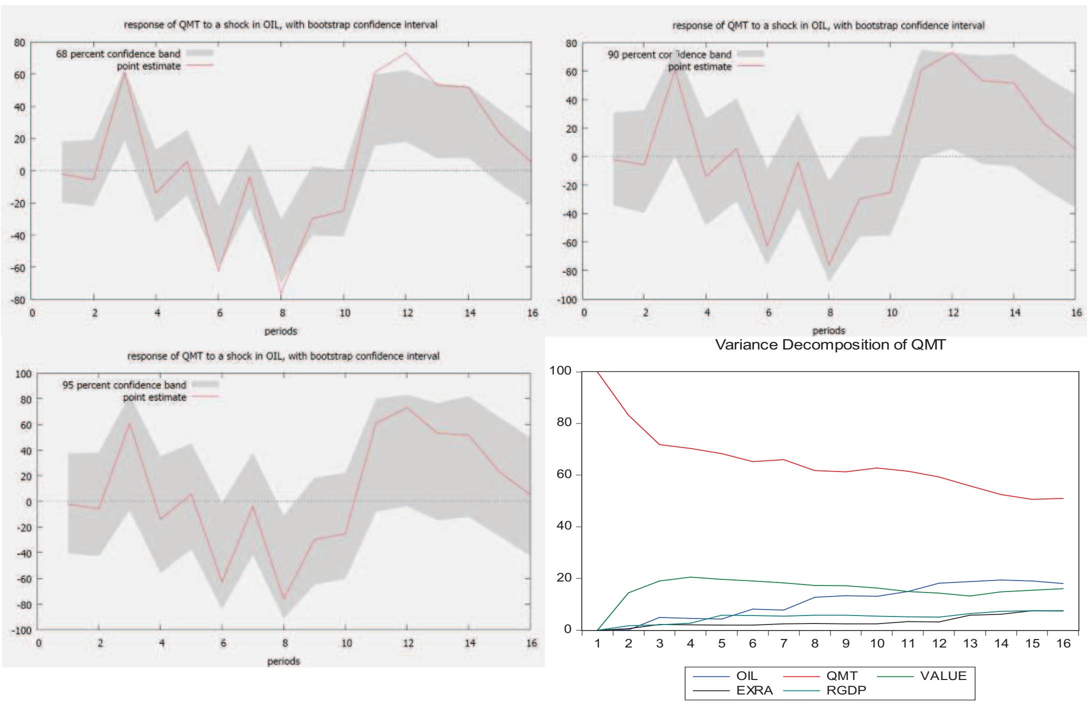
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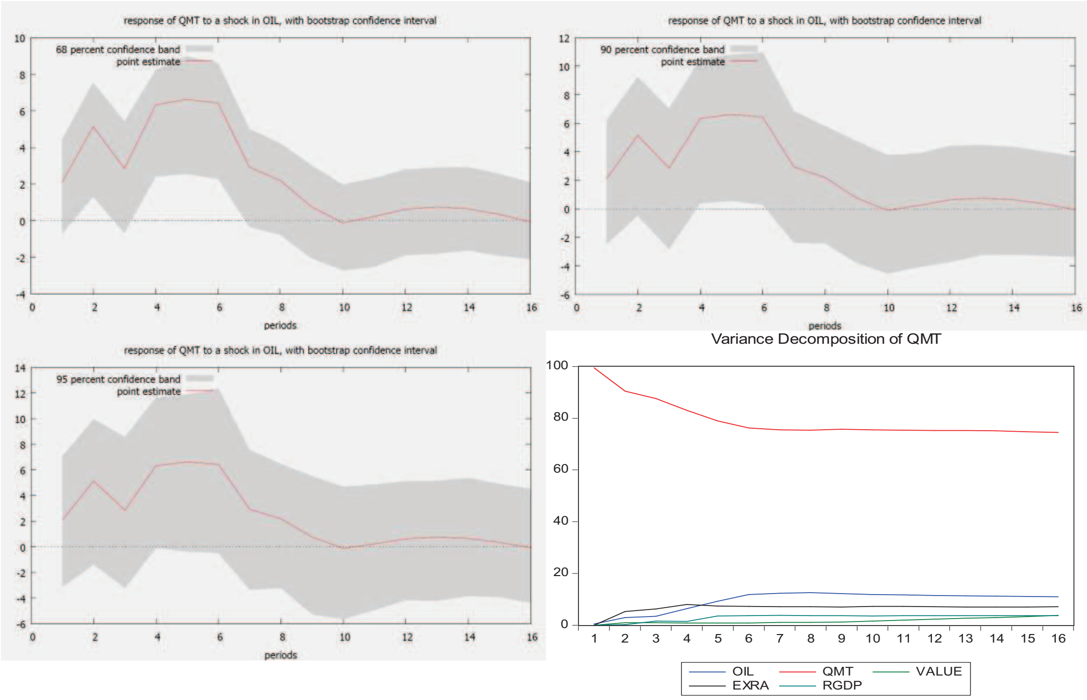
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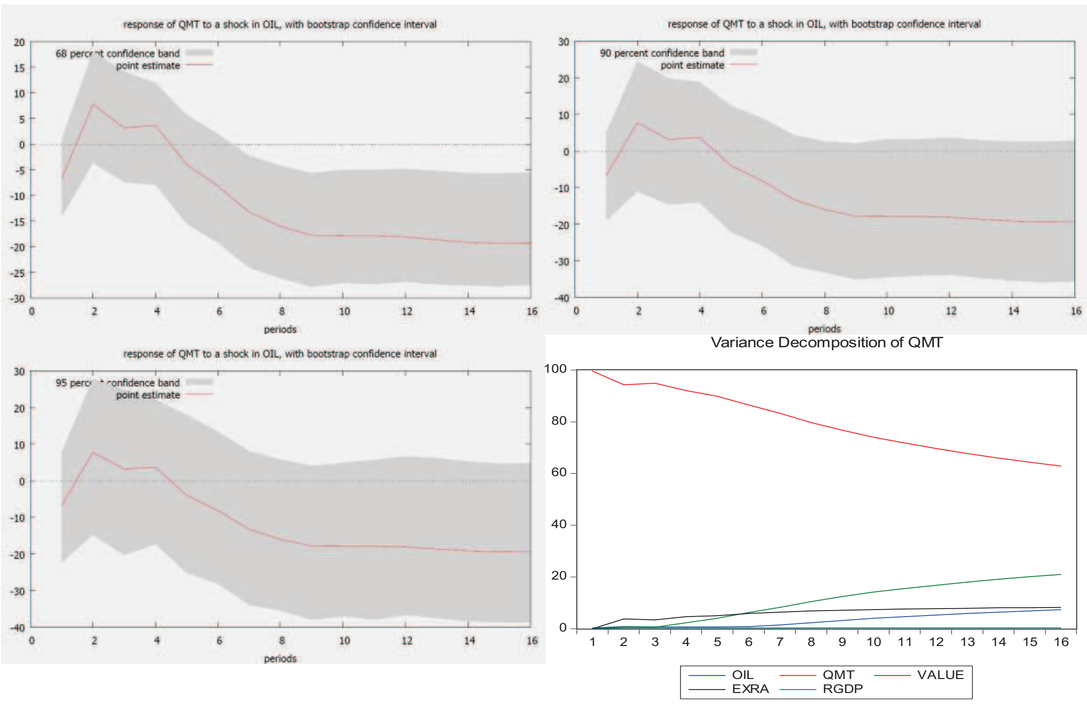
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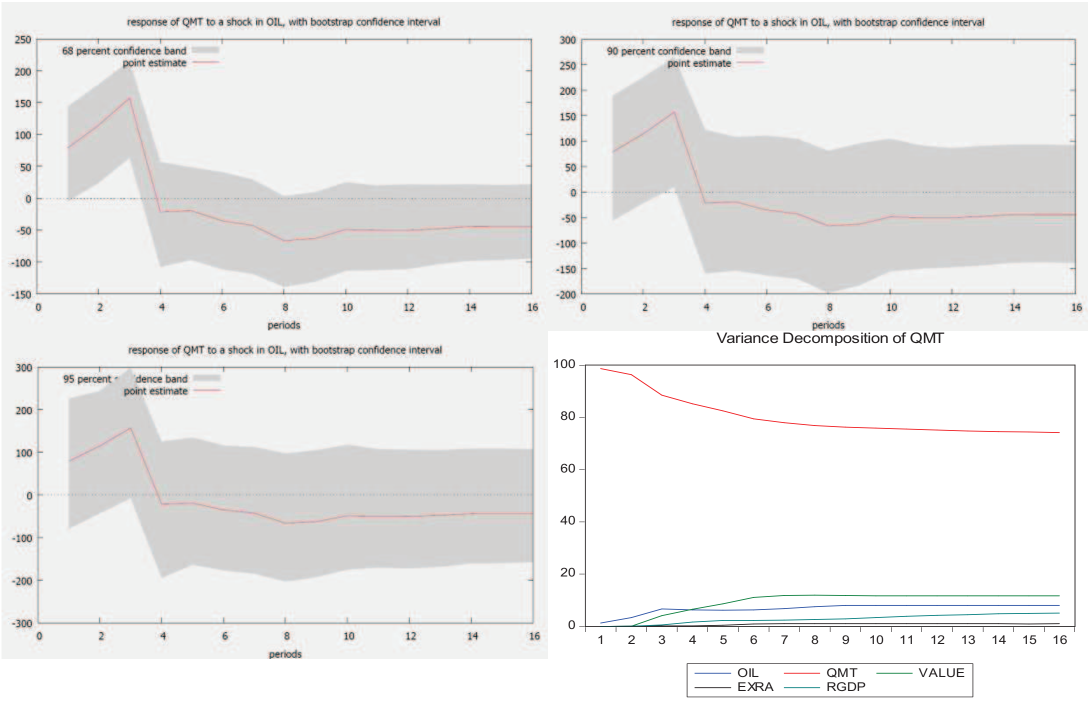
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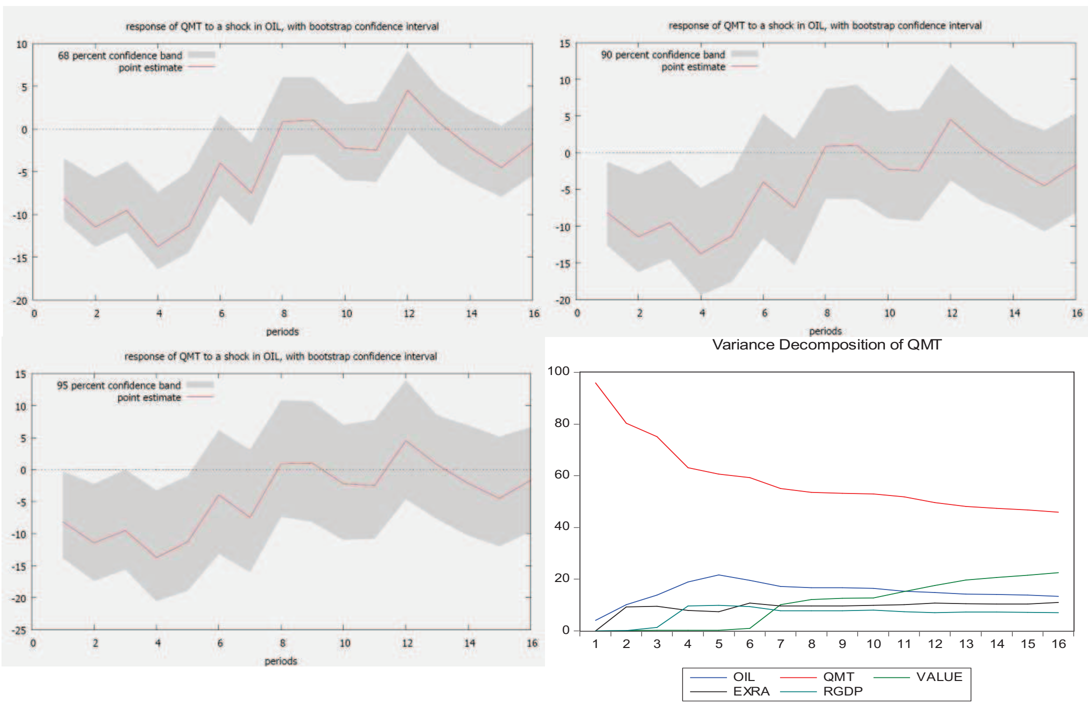
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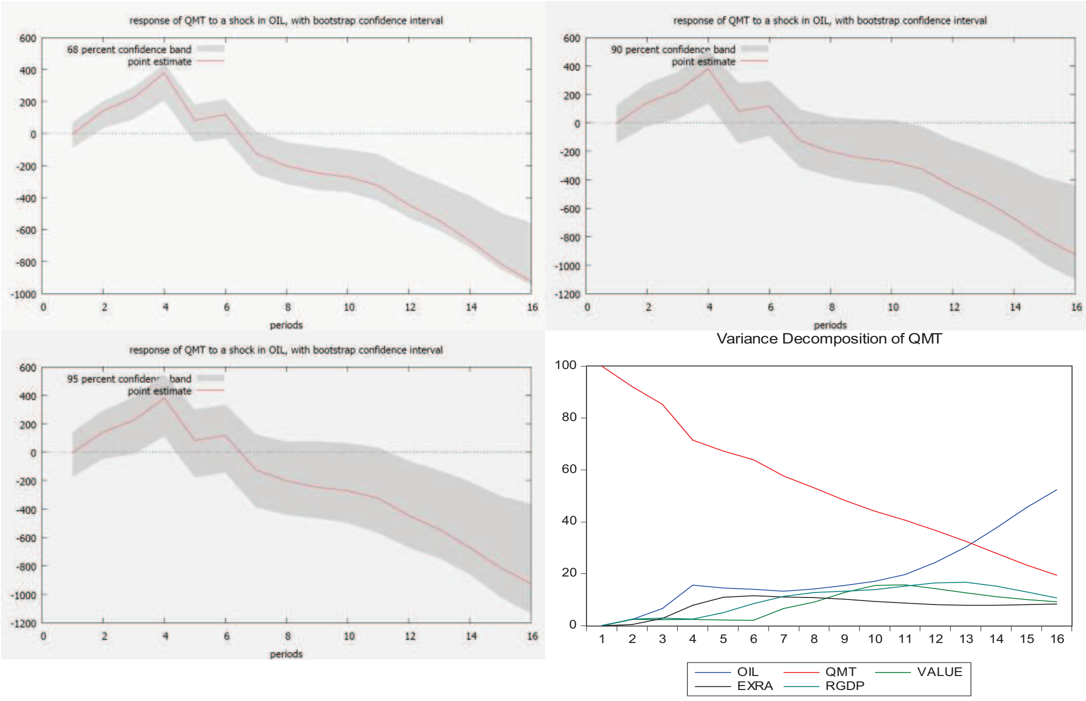
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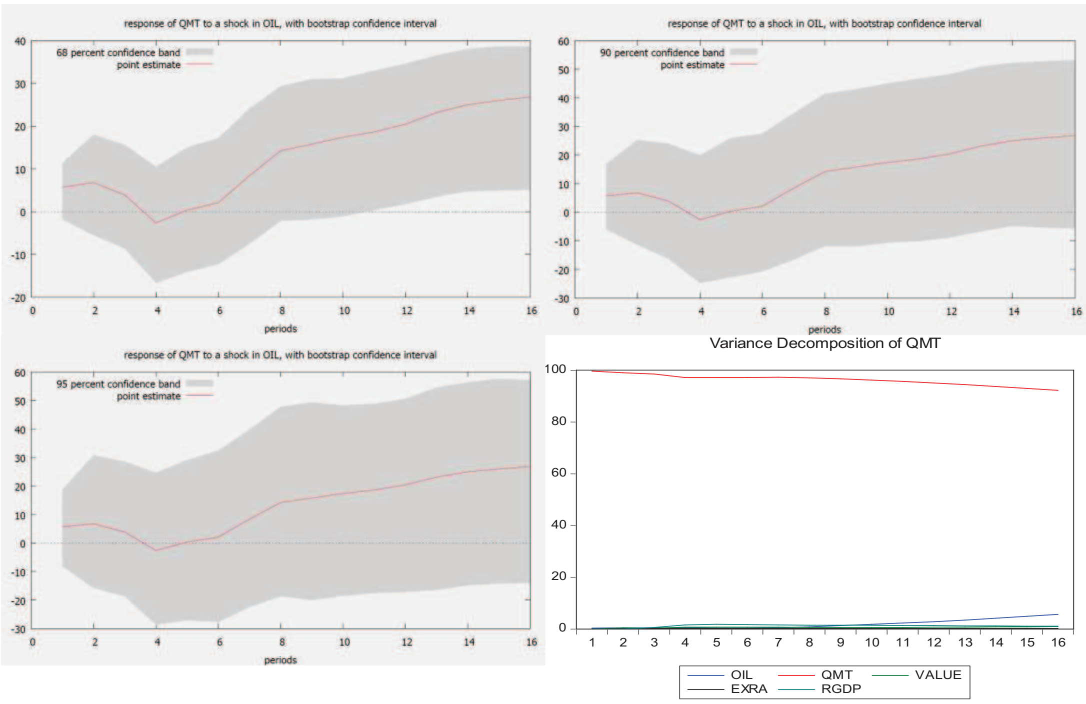
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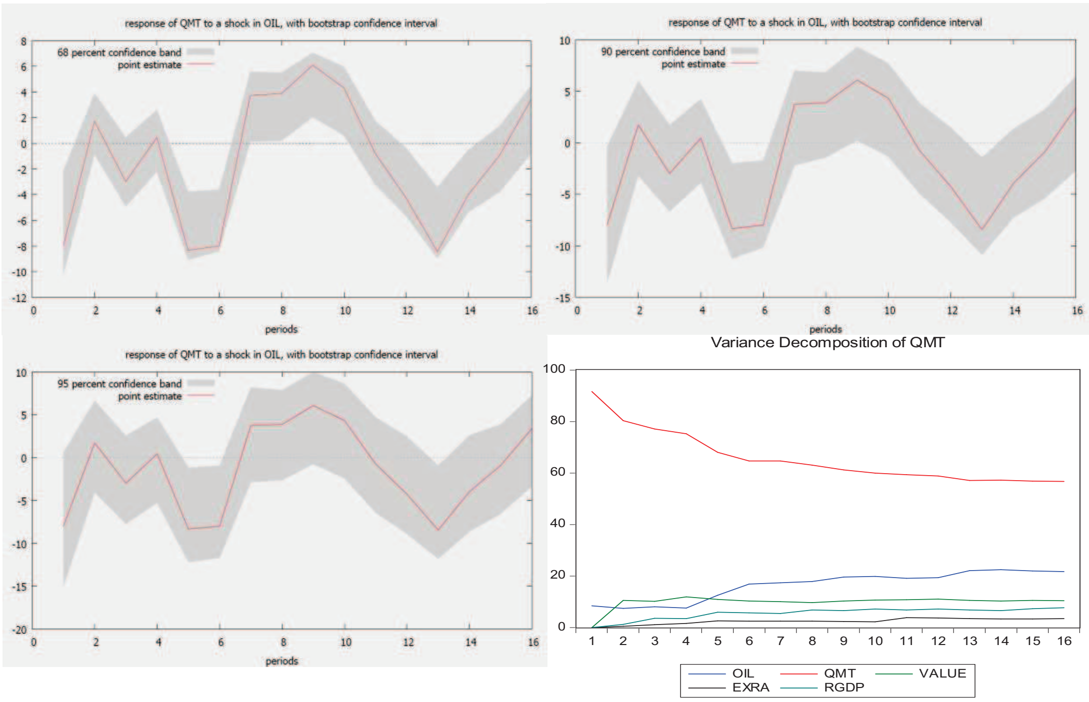
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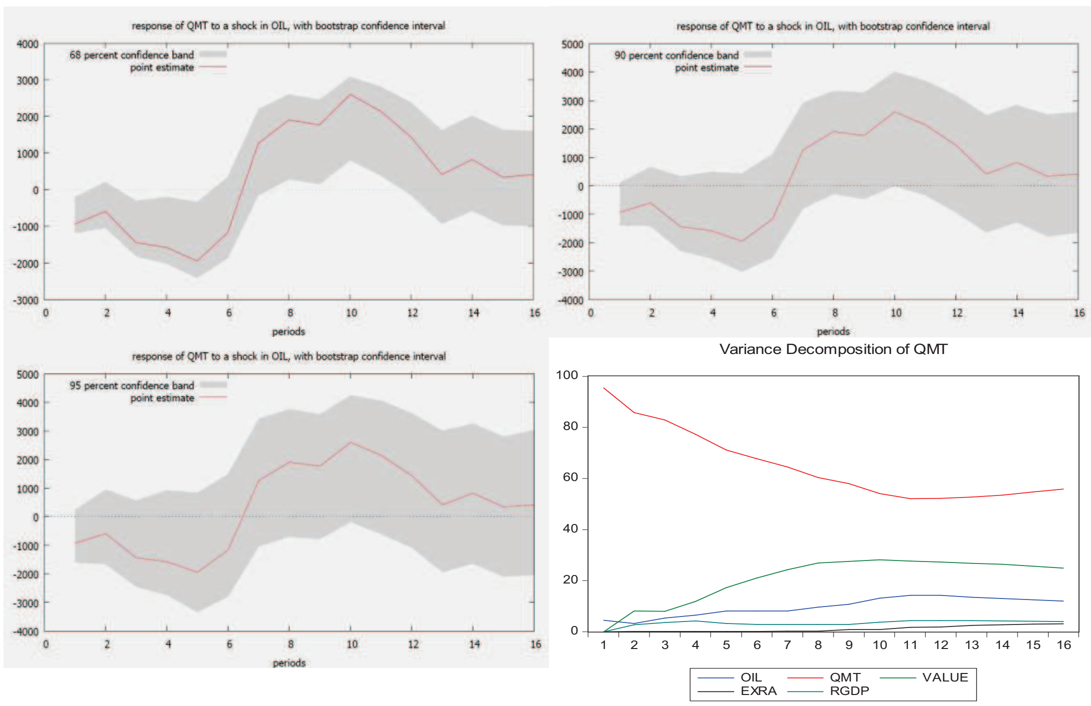
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VALUE
EXRA
RGDP

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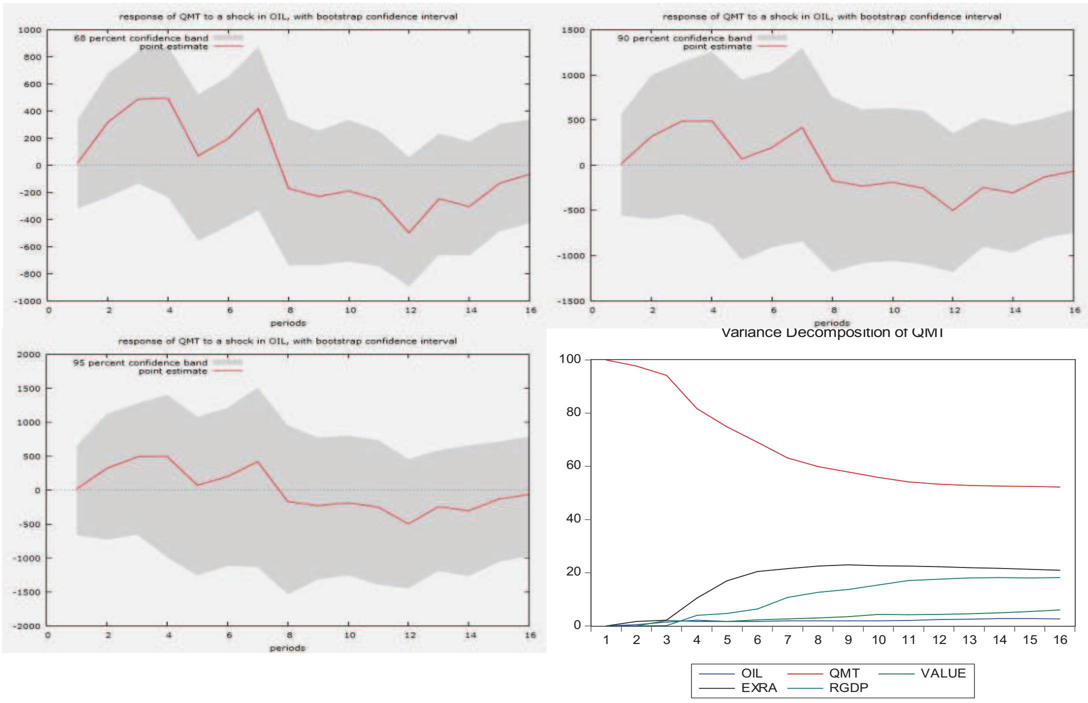
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68 percent confidence band
point estimate
periods
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90 percent confidence band
point estimate
periods
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95 percent confidence band
point estimate
periods
Variance Decomposition of QMT
OIL
QMT
VALUE
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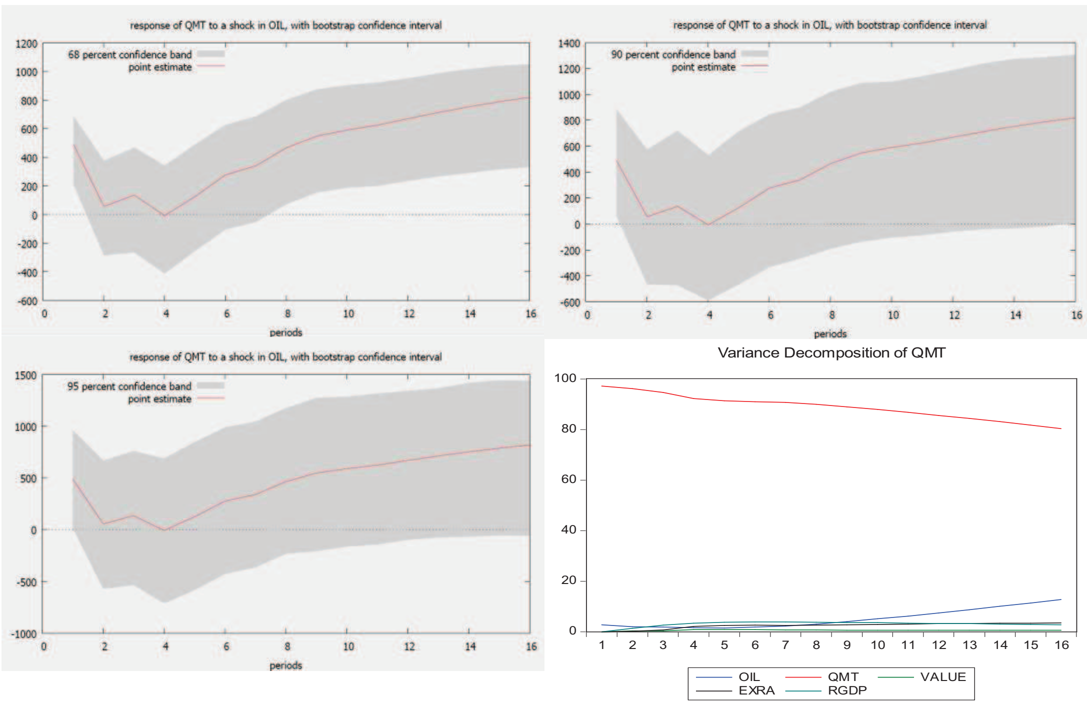
RGDP

33A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periods
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periods
Variance Decomposition of QMT
OIL
QMT
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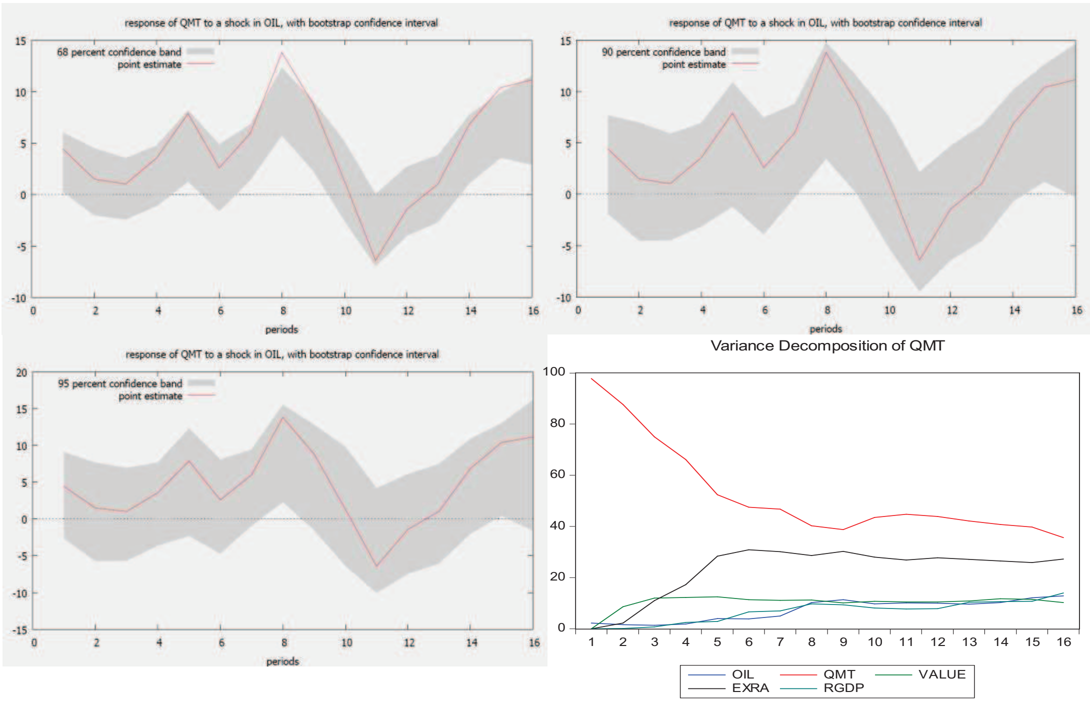
RGDP

33B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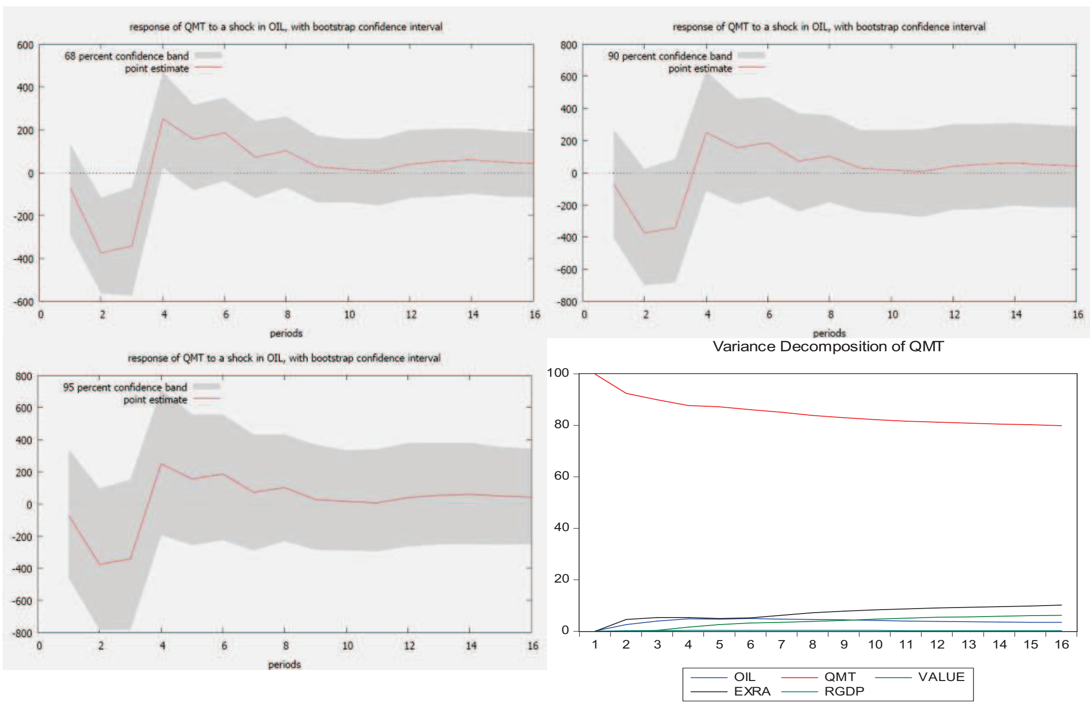
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RGDP

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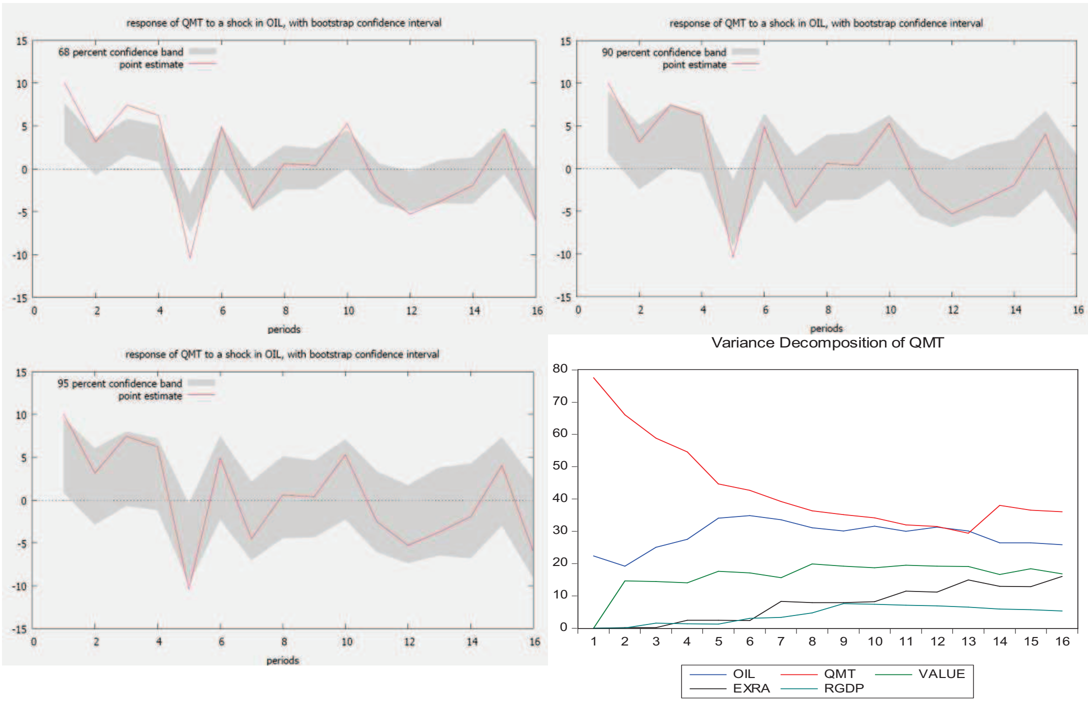
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point estimate
periods
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OIL
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VALUE
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RGDP

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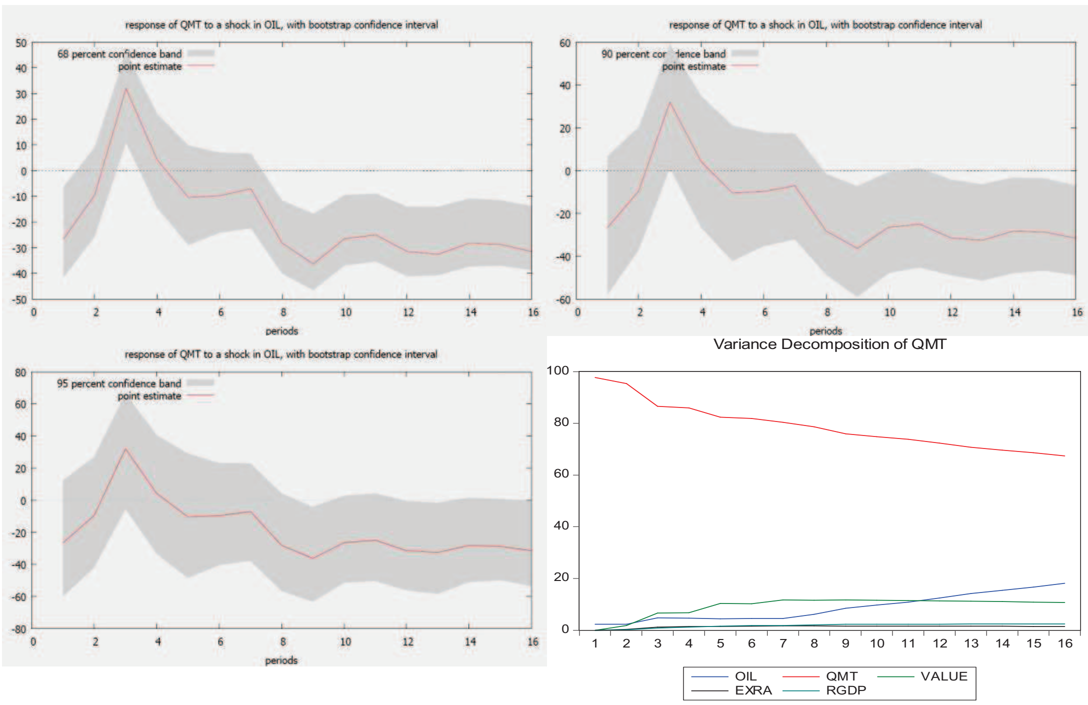
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OIL
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RGDP

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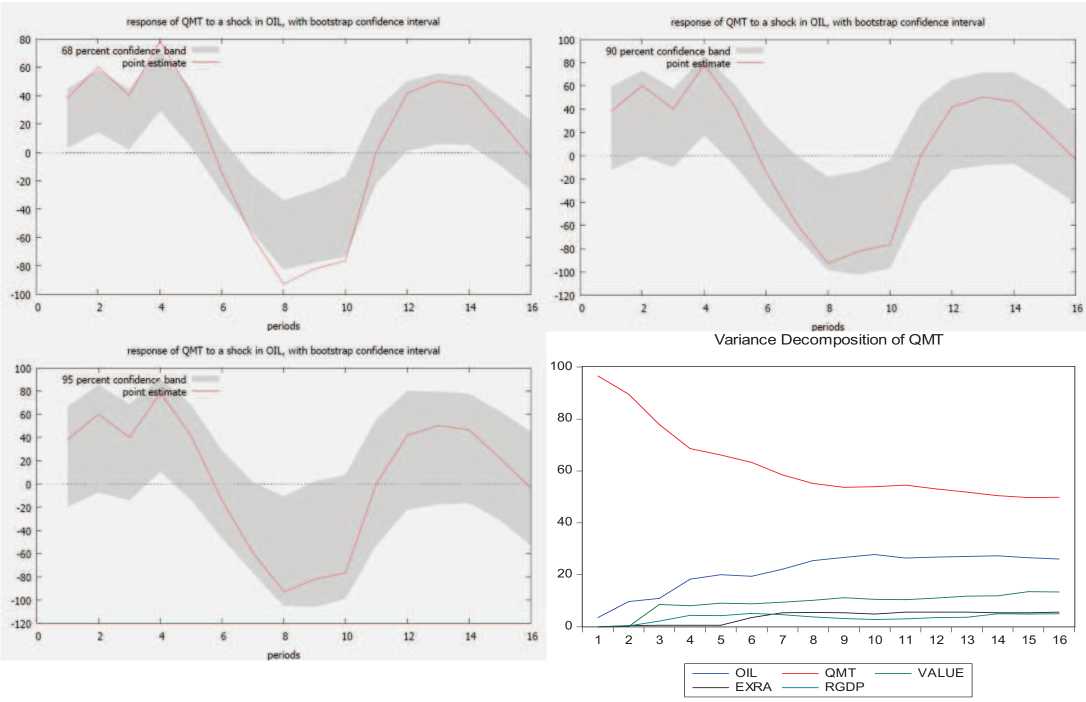
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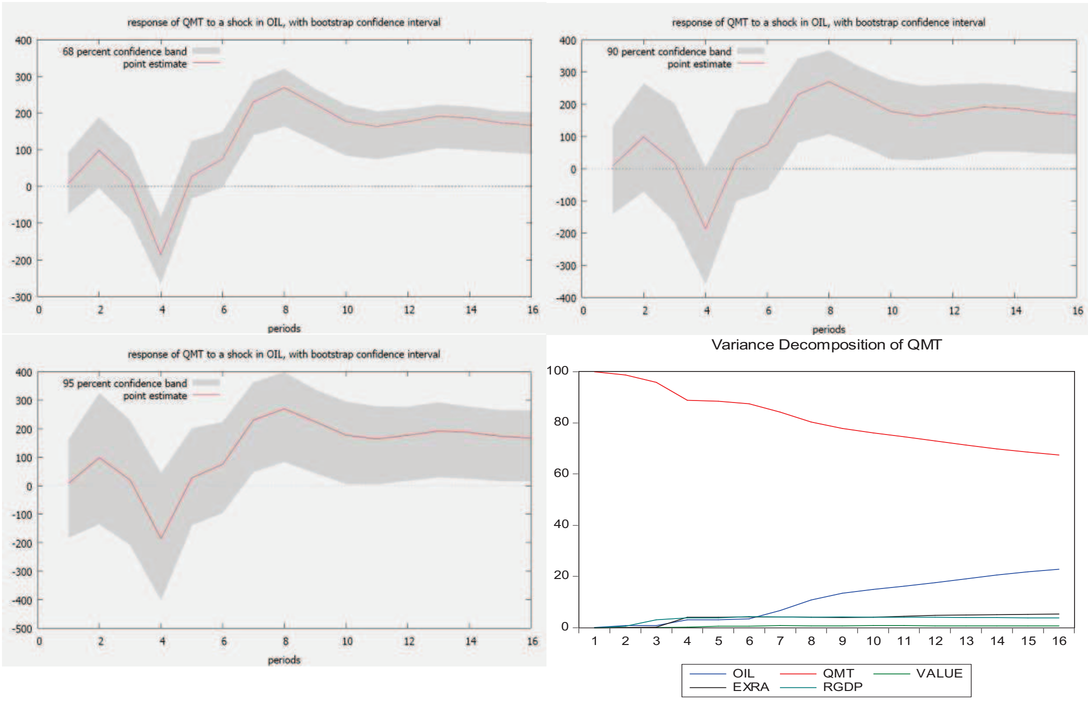
OIL
QMT
VALUE
EXRA
RGDP

4.2.4 South America (Brazil)

1A



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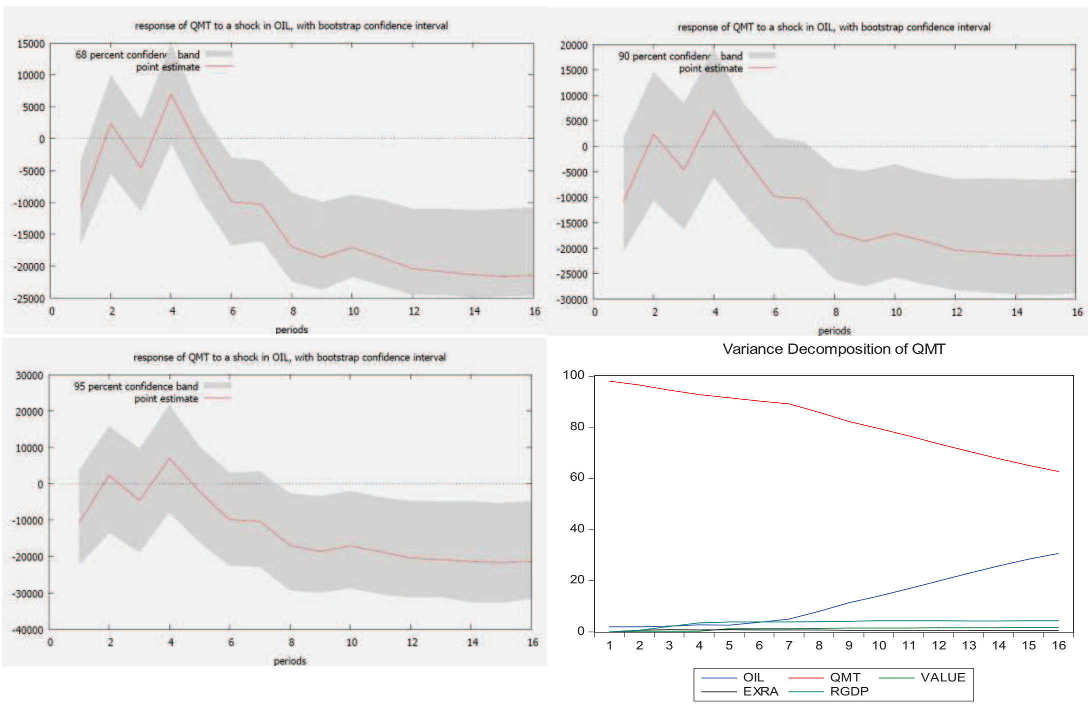

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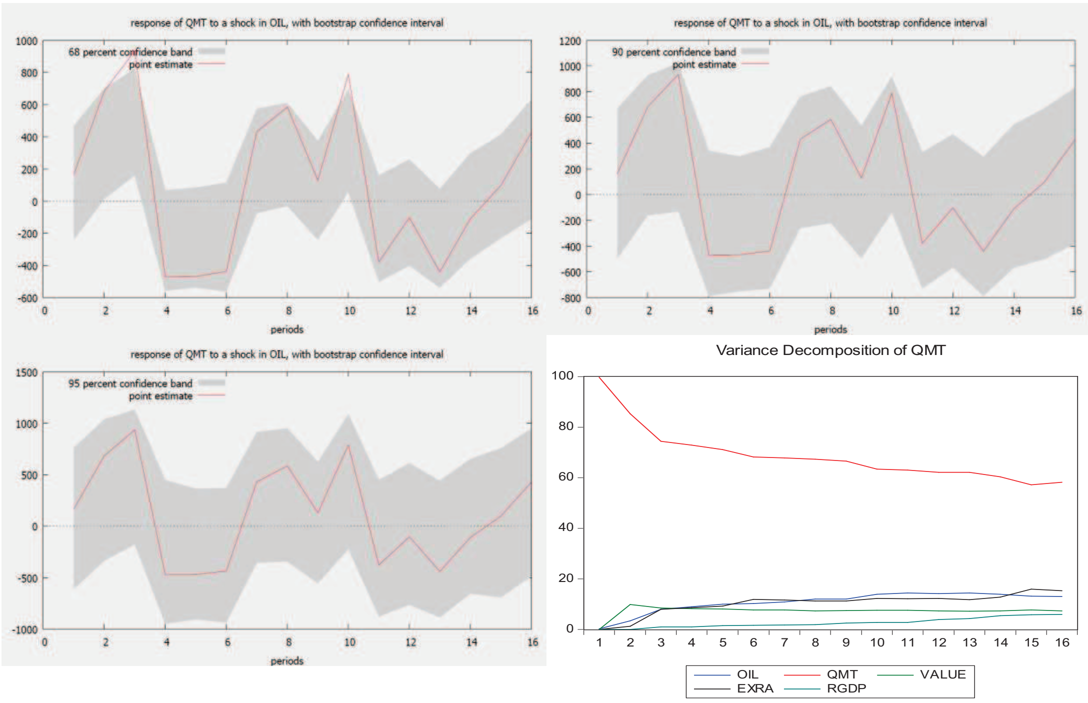
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OIL
QMT
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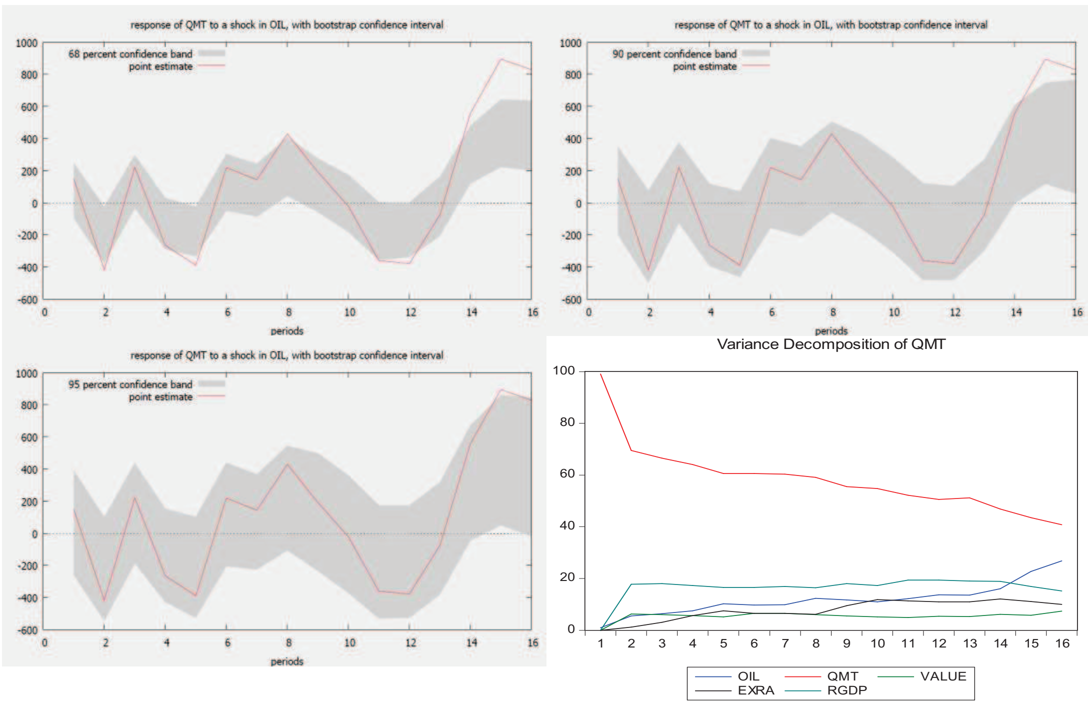
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OIL
QMT
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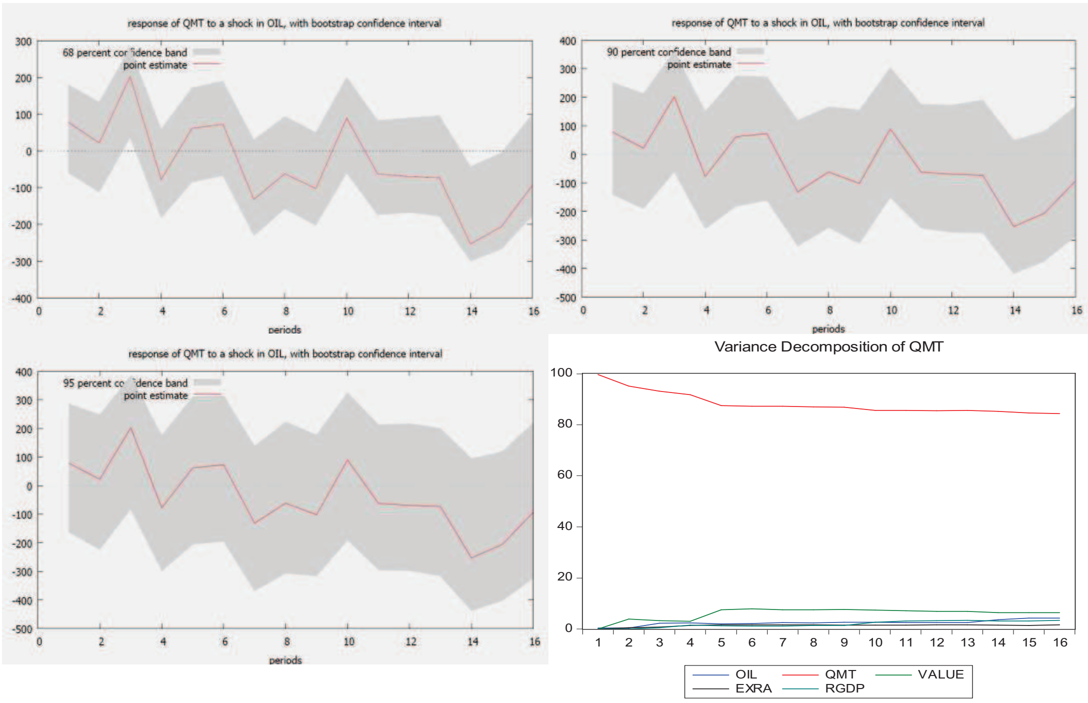
RGDP

6A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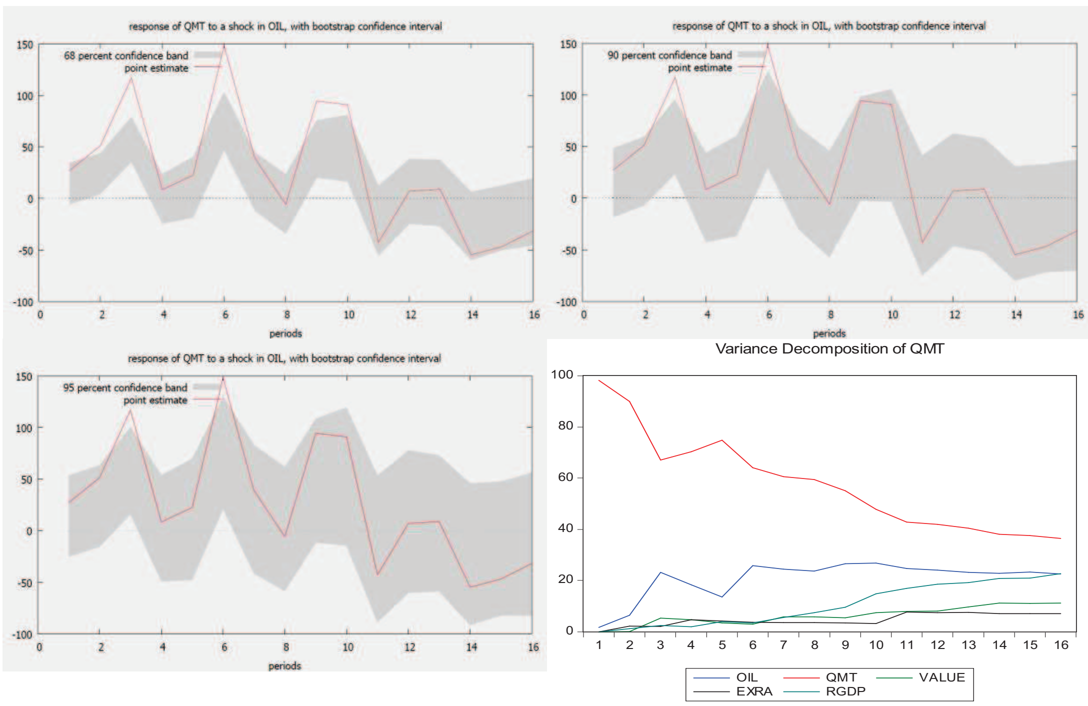
RGDP

6B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OIL
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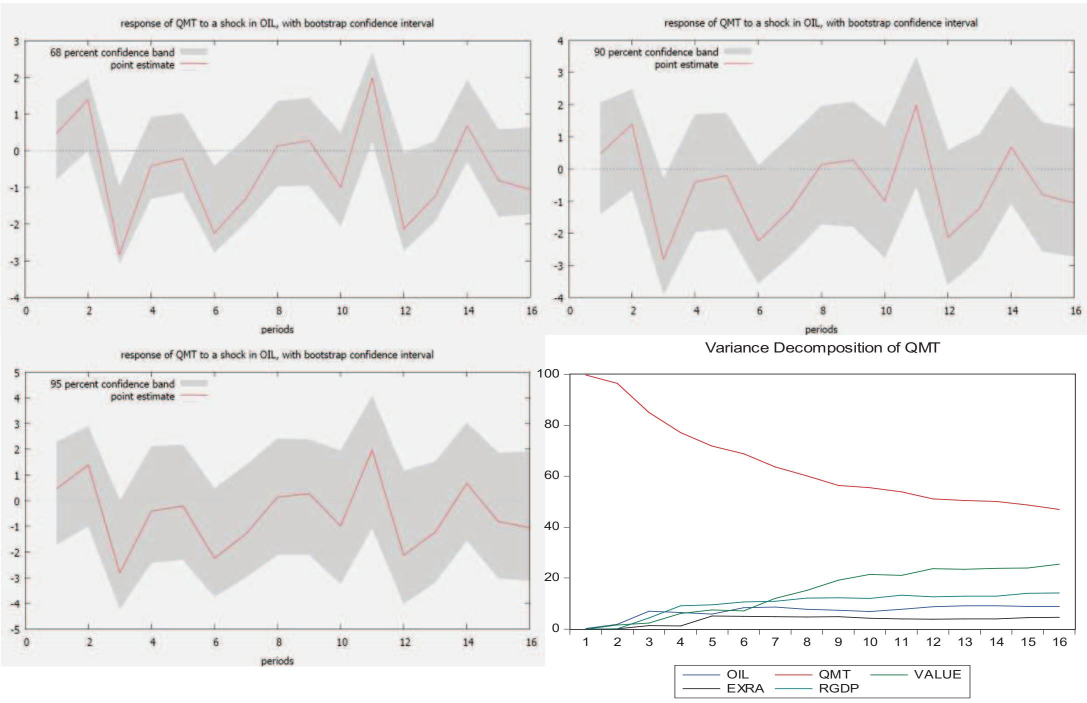
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RGDP

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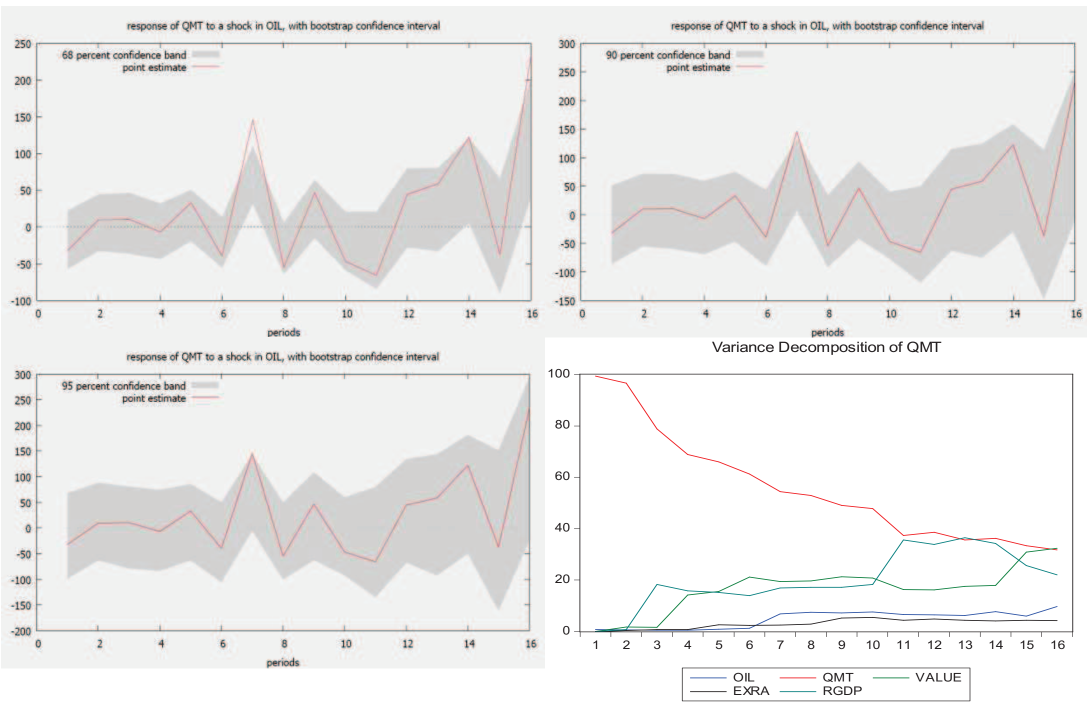
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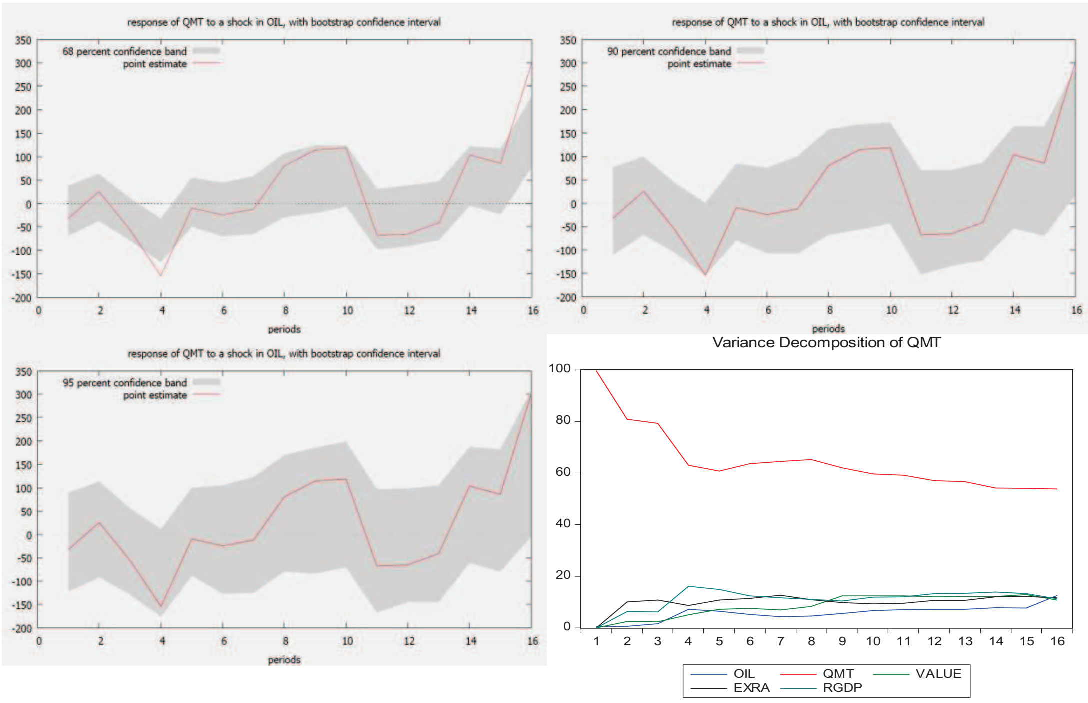
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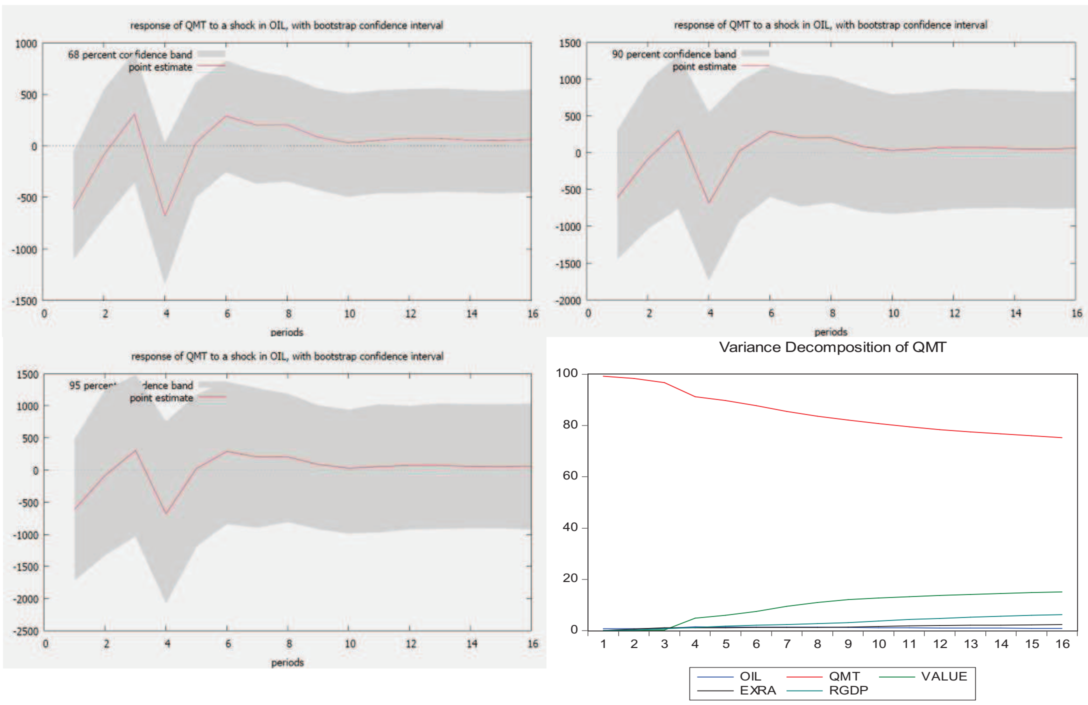
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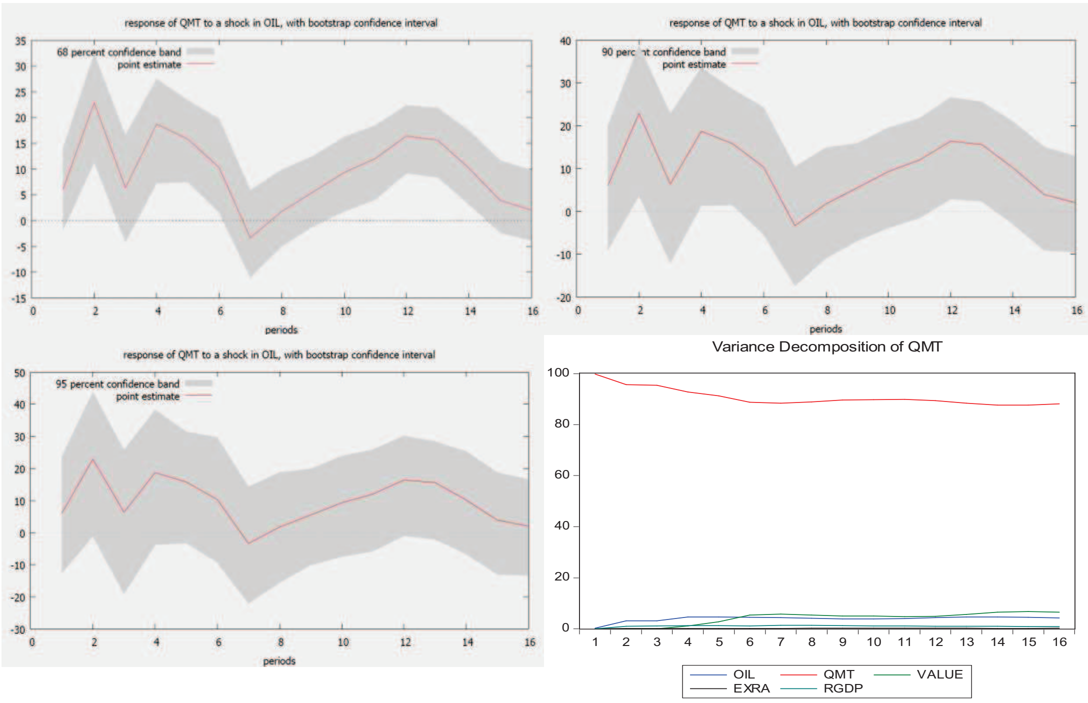
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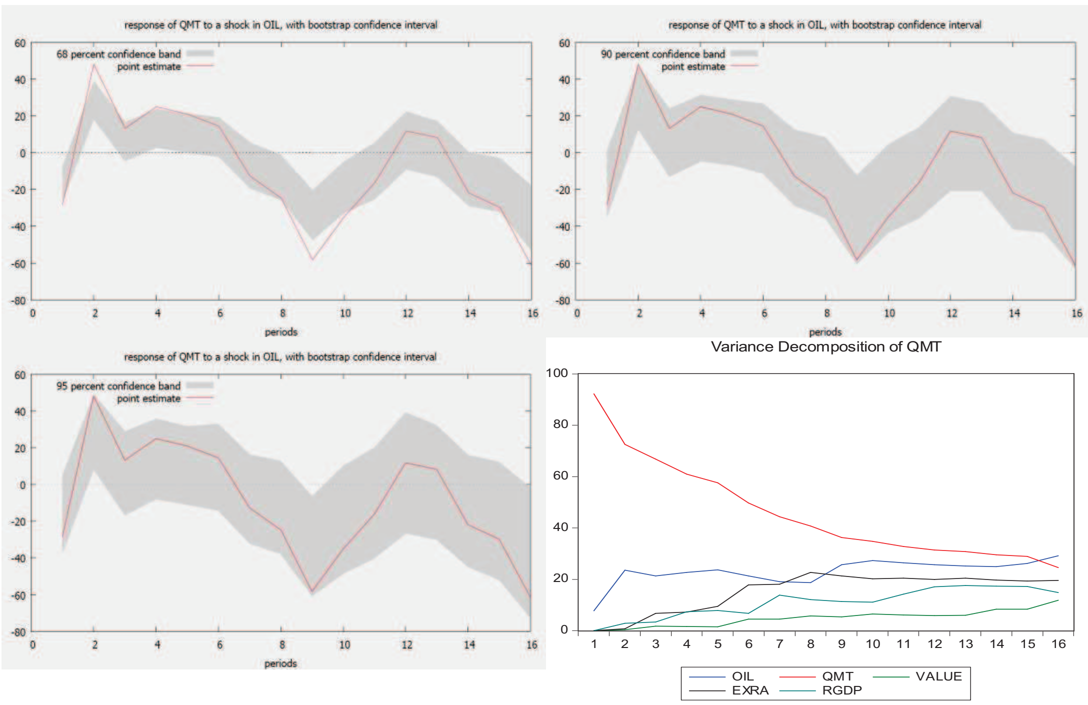
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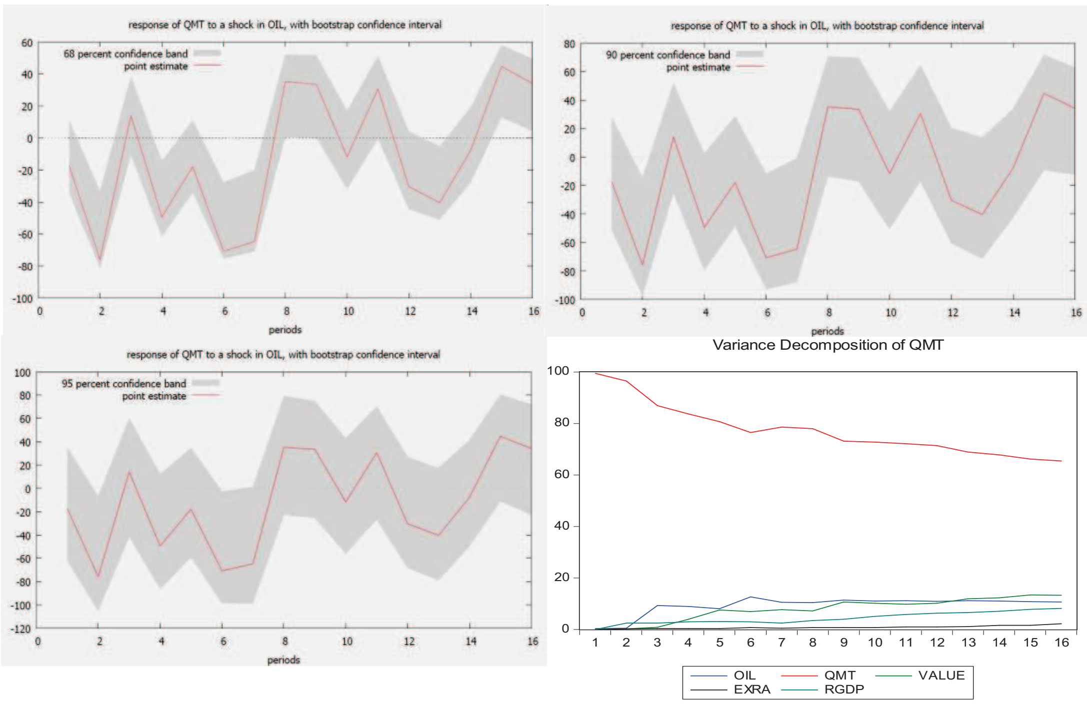
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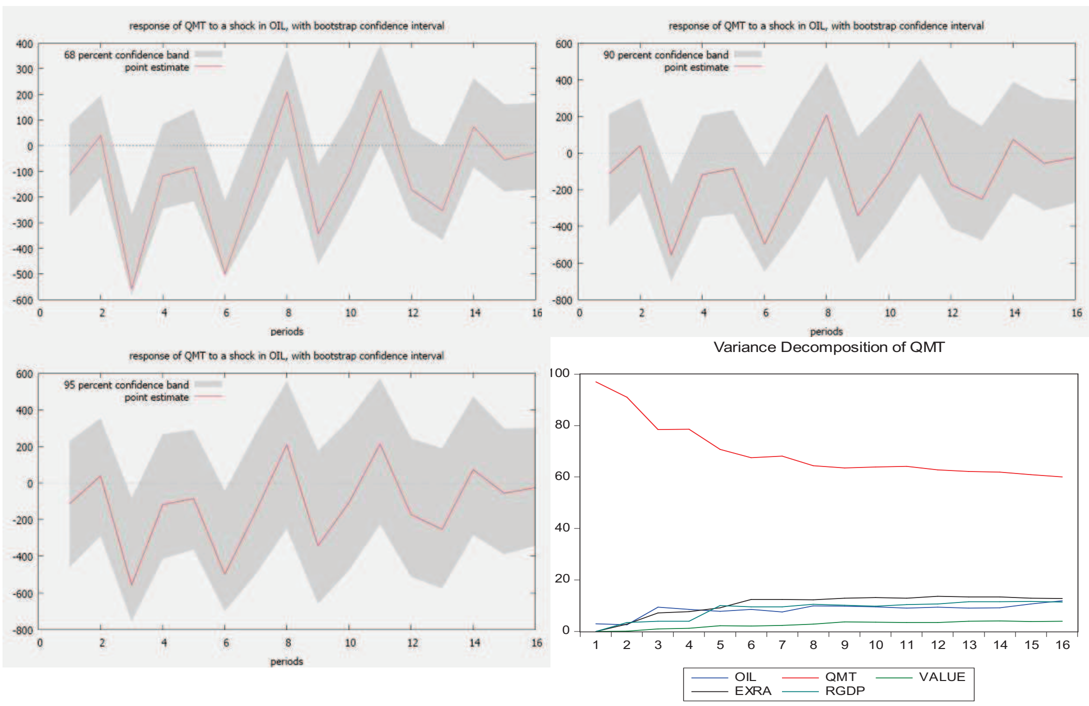
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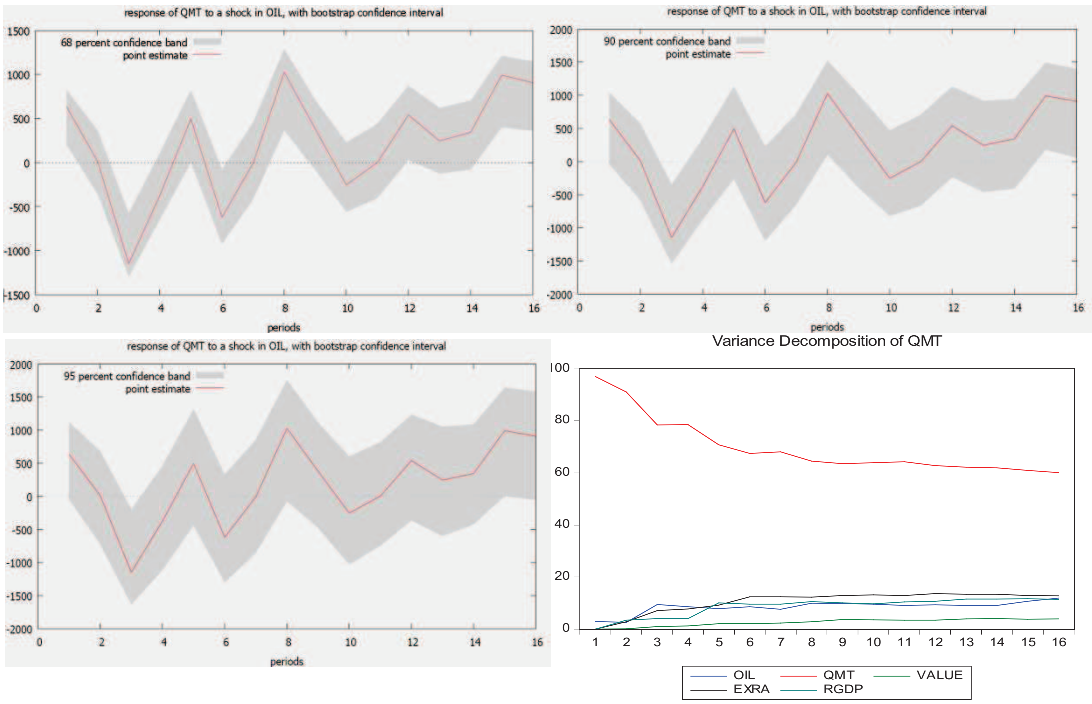
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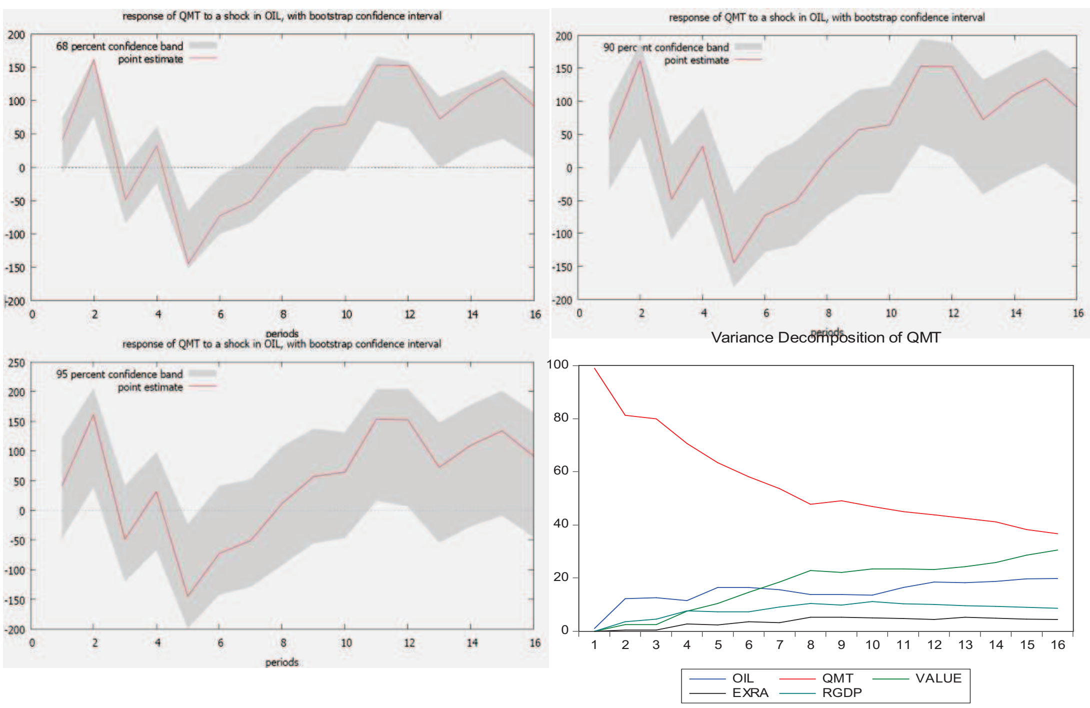
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RGDP

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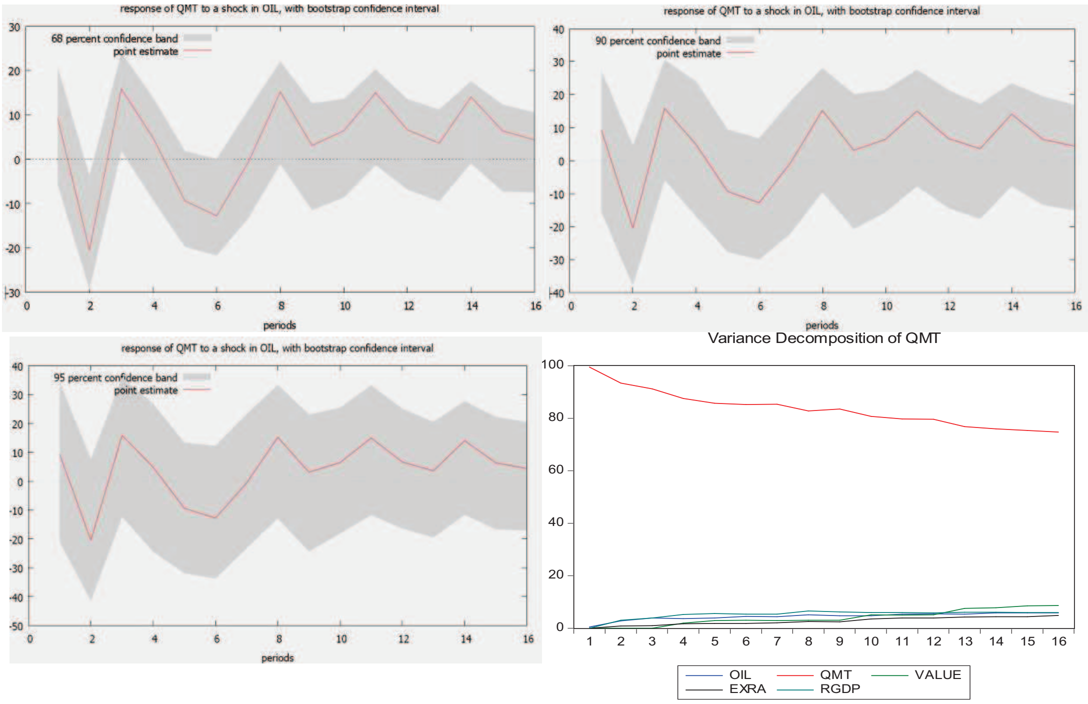
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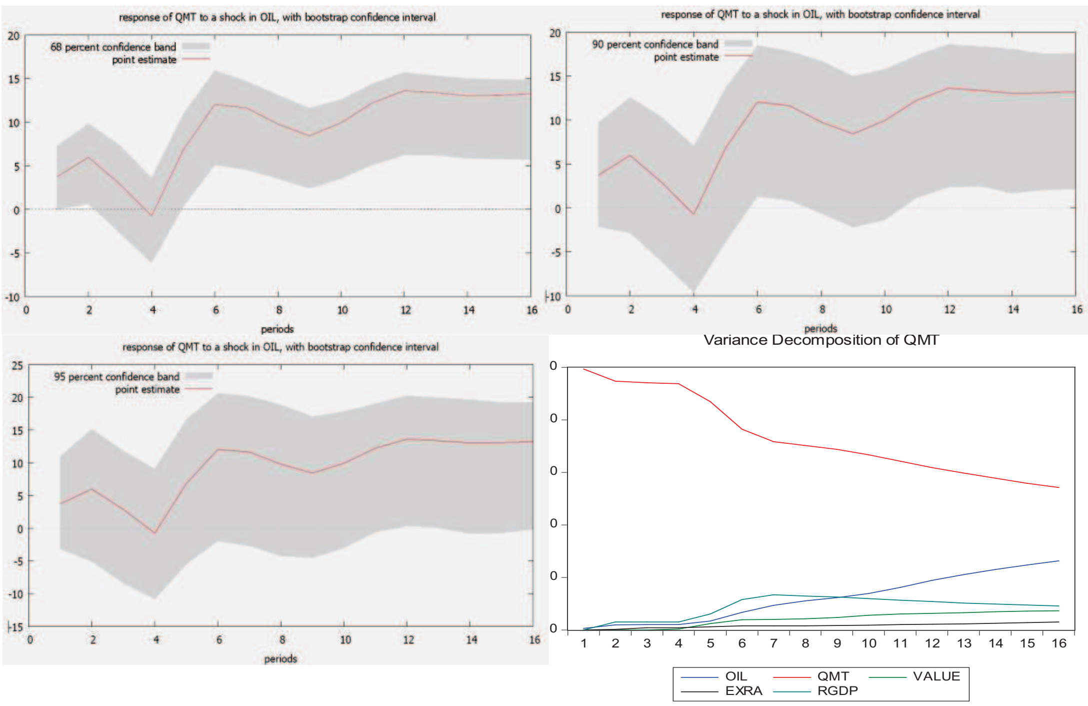
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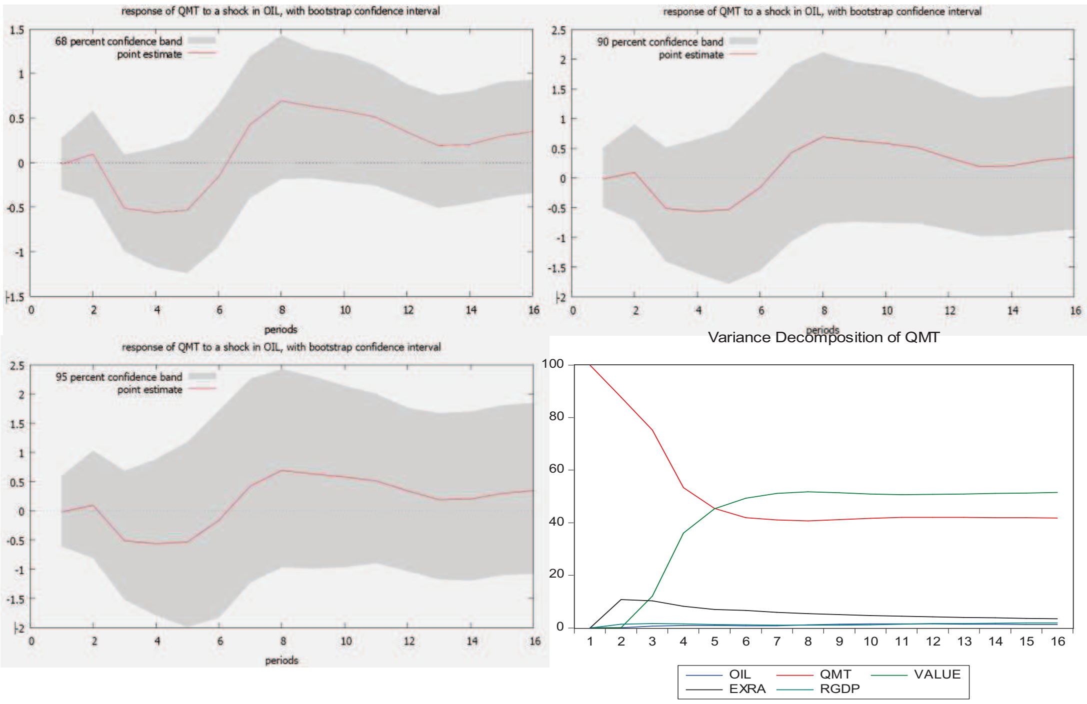
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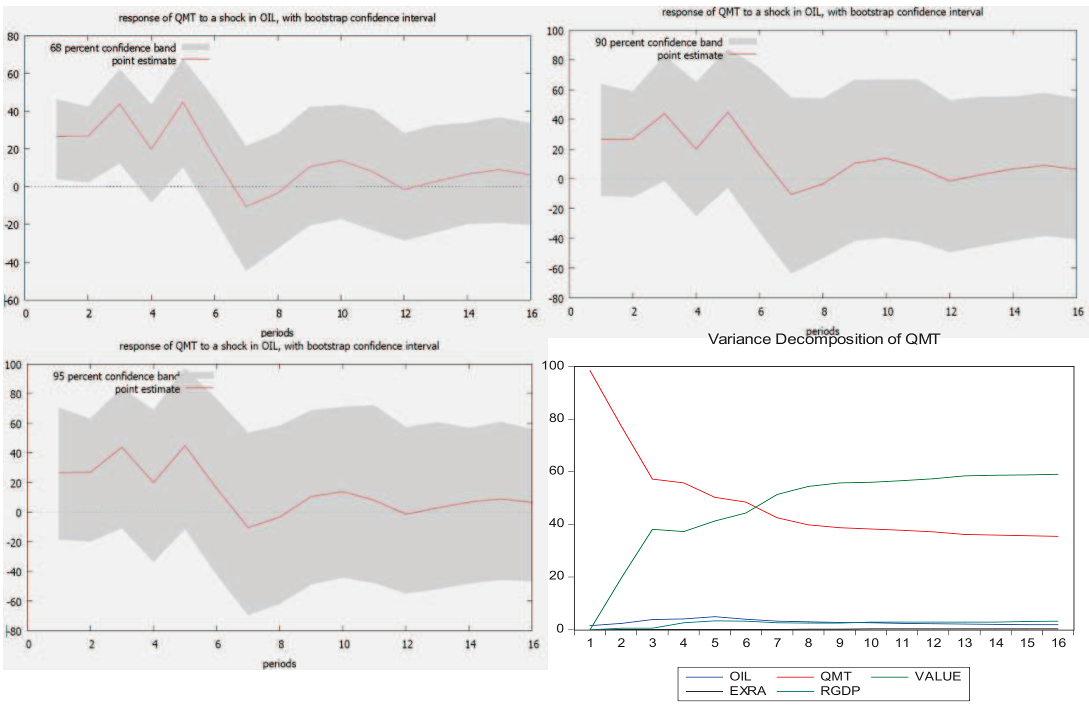
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RGDP

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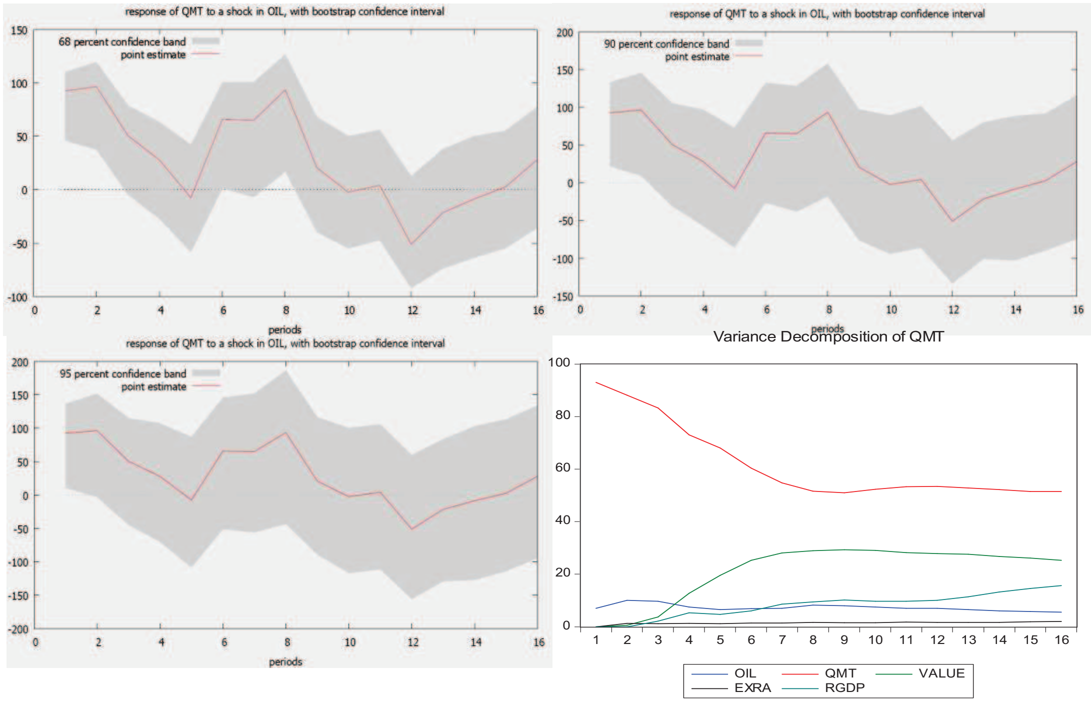
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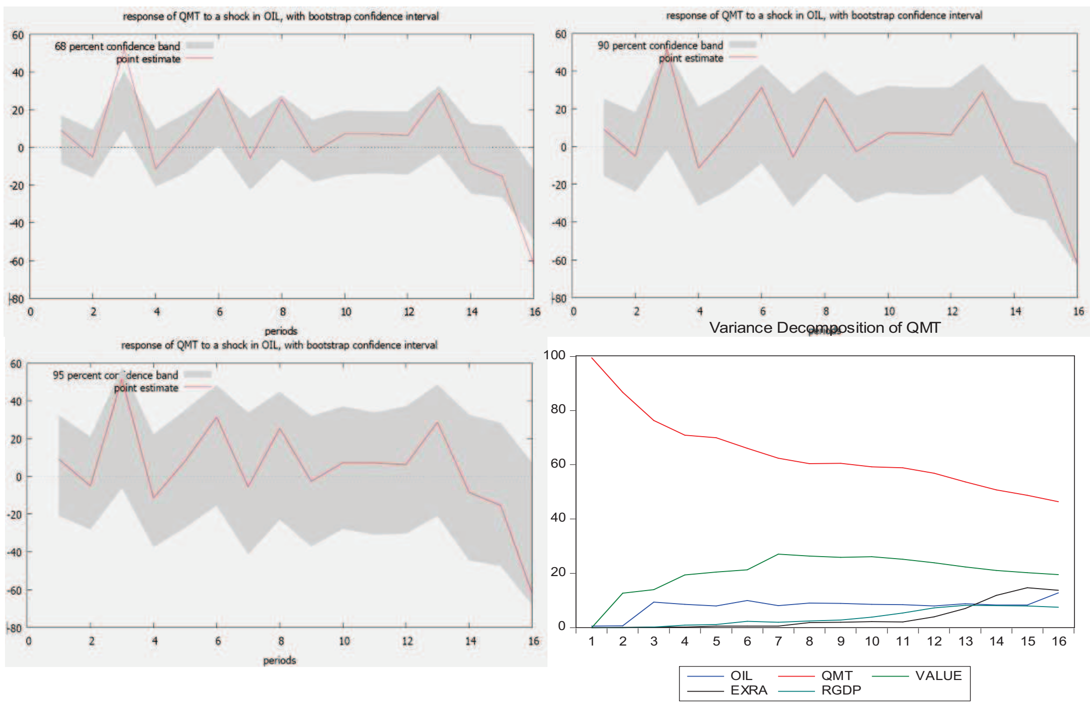
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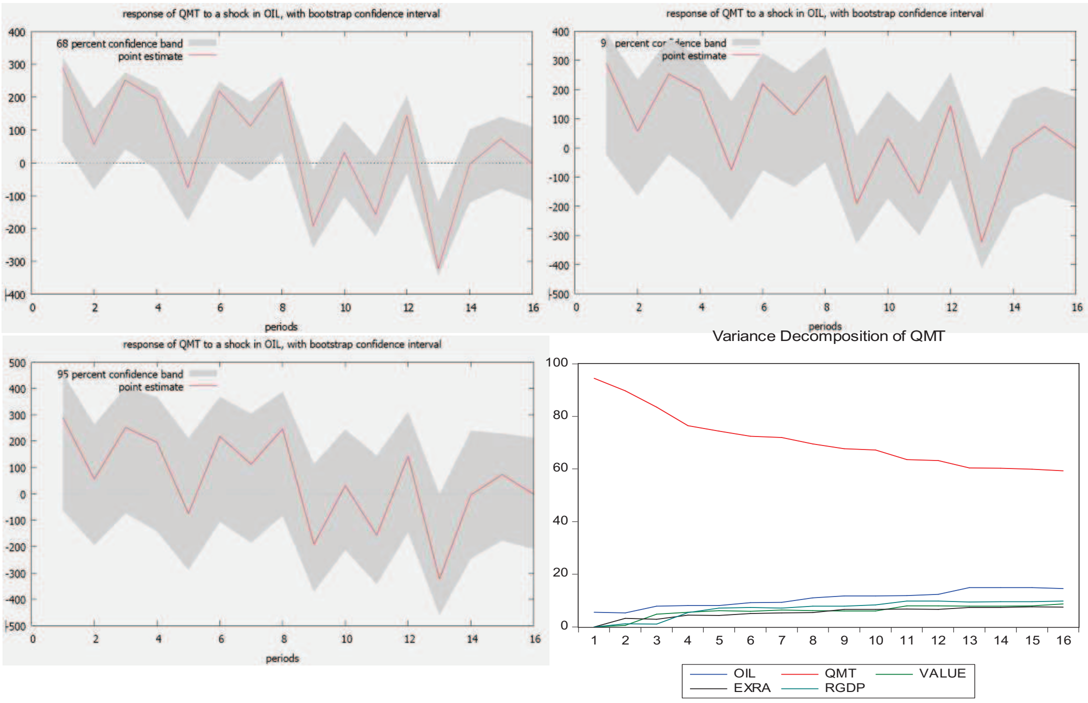
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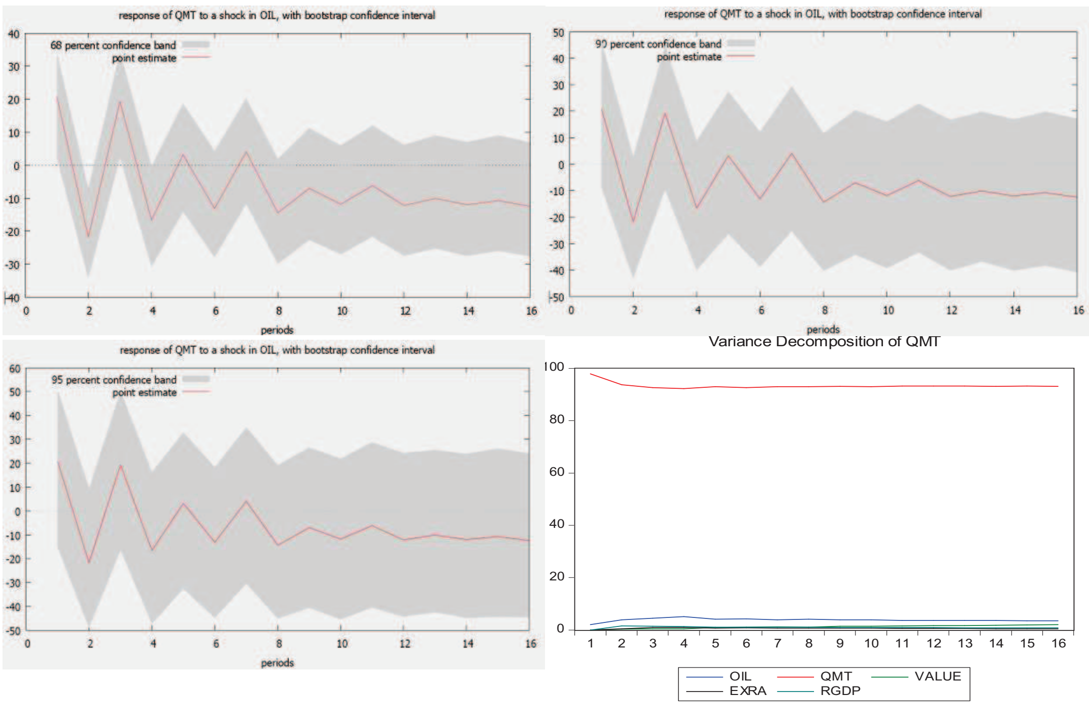
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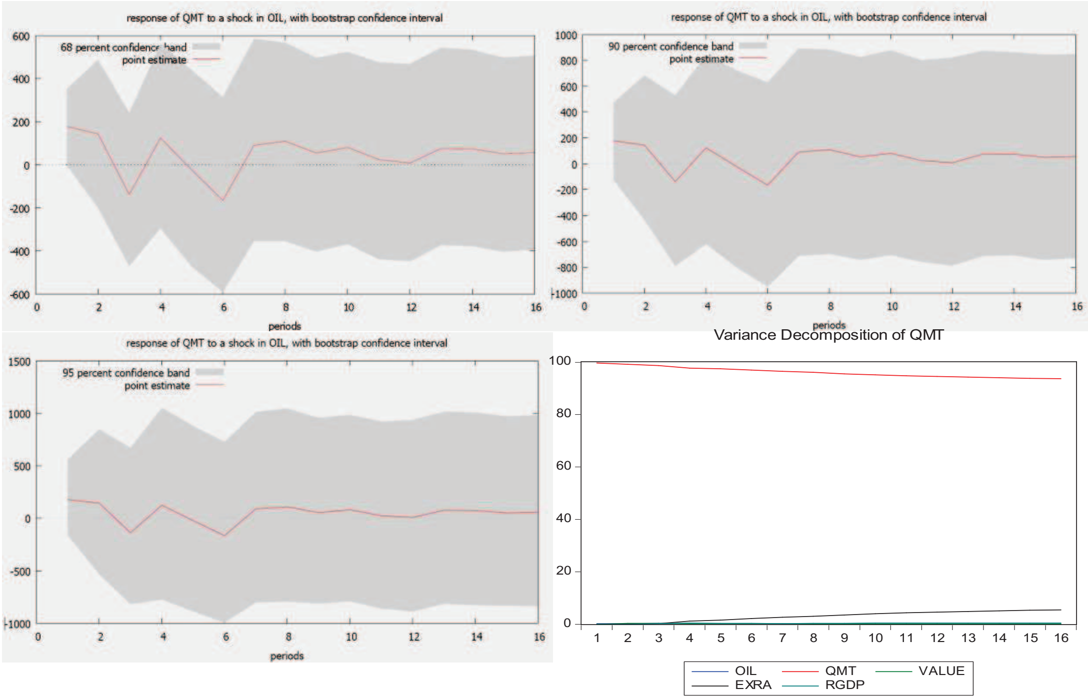
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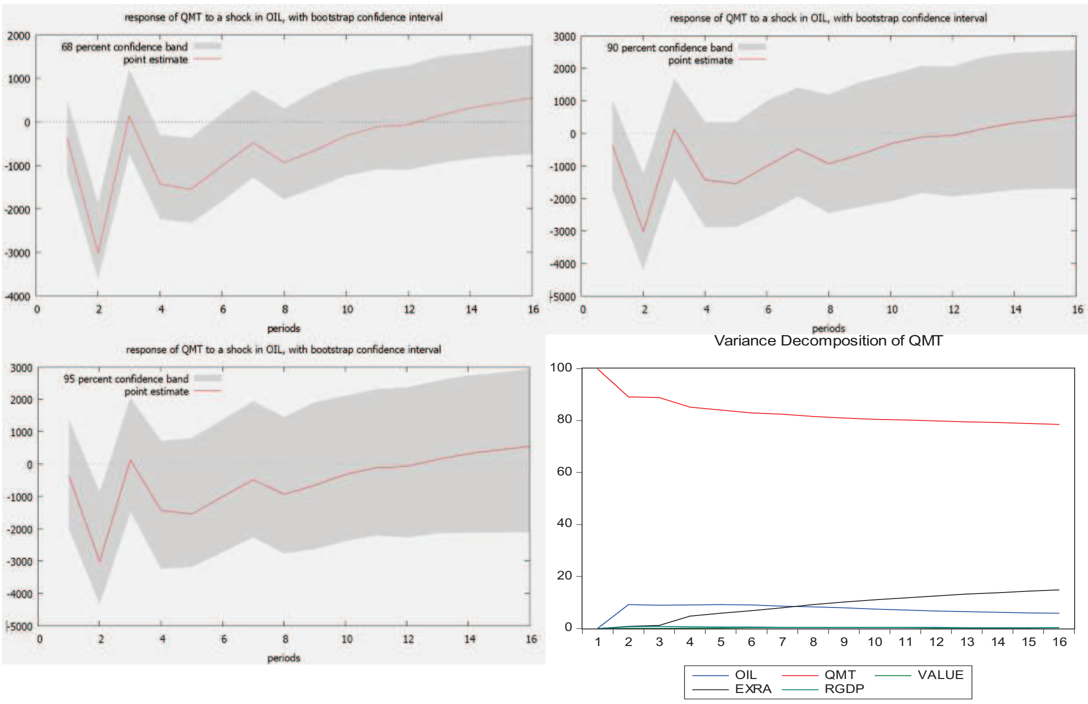
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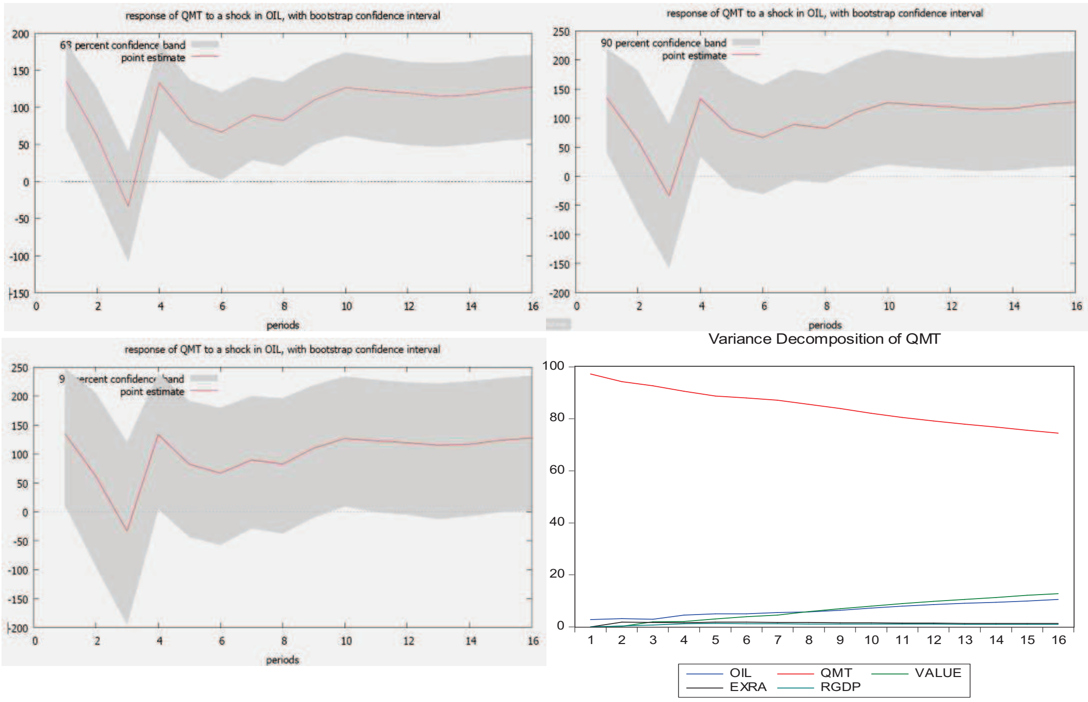
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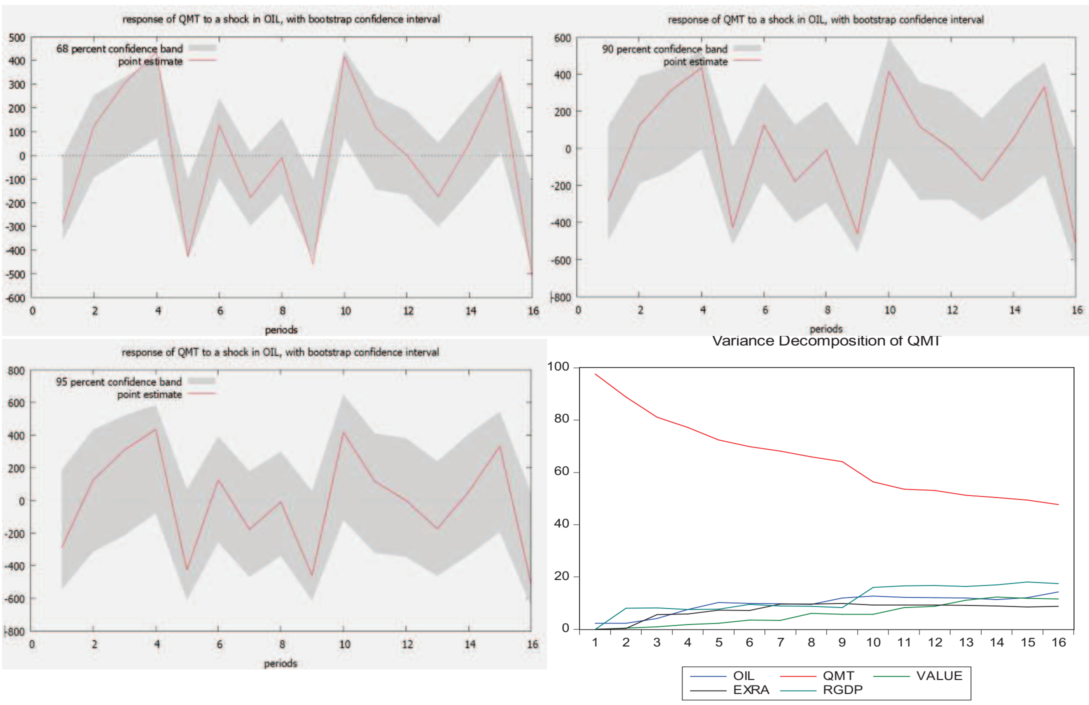
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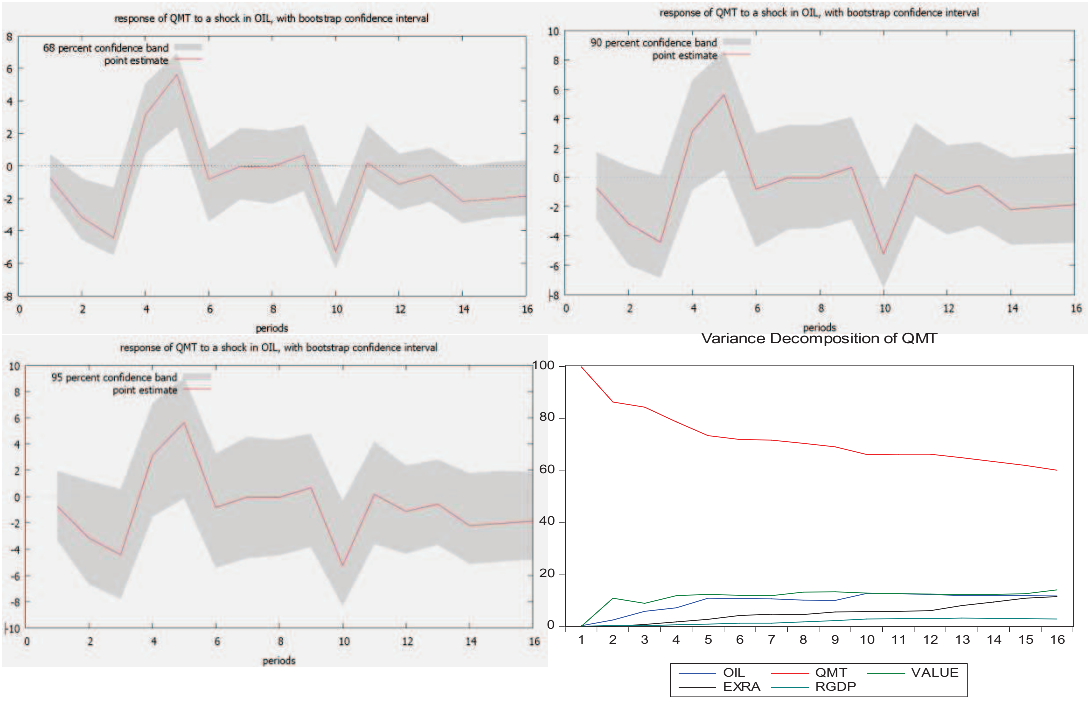
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QMT
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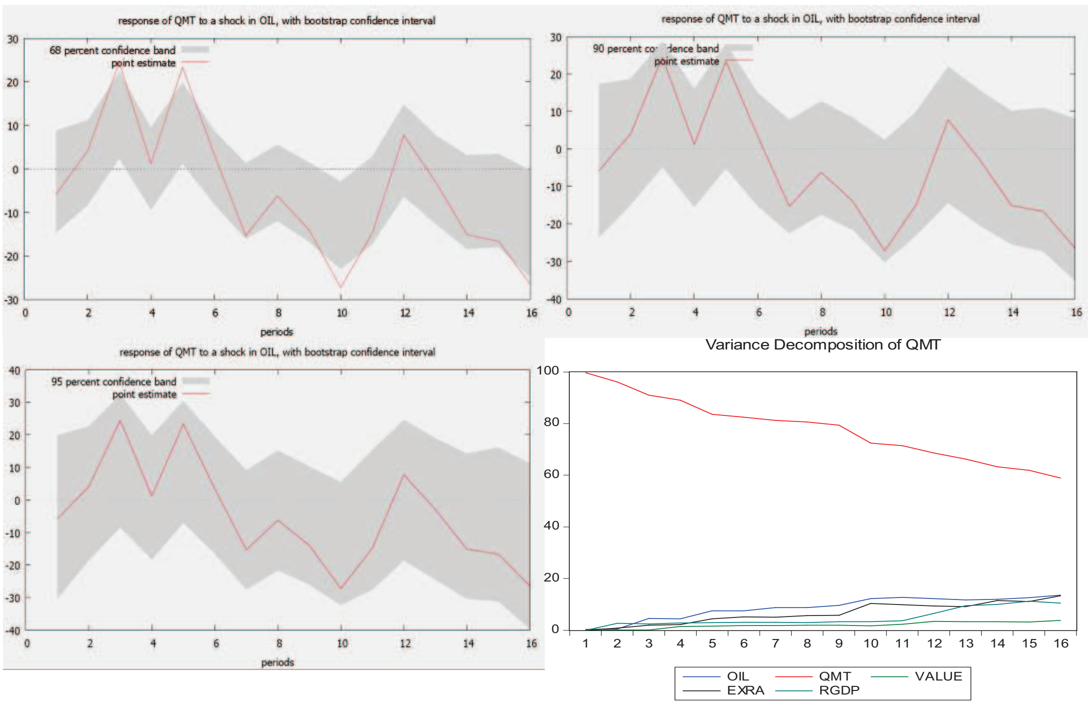
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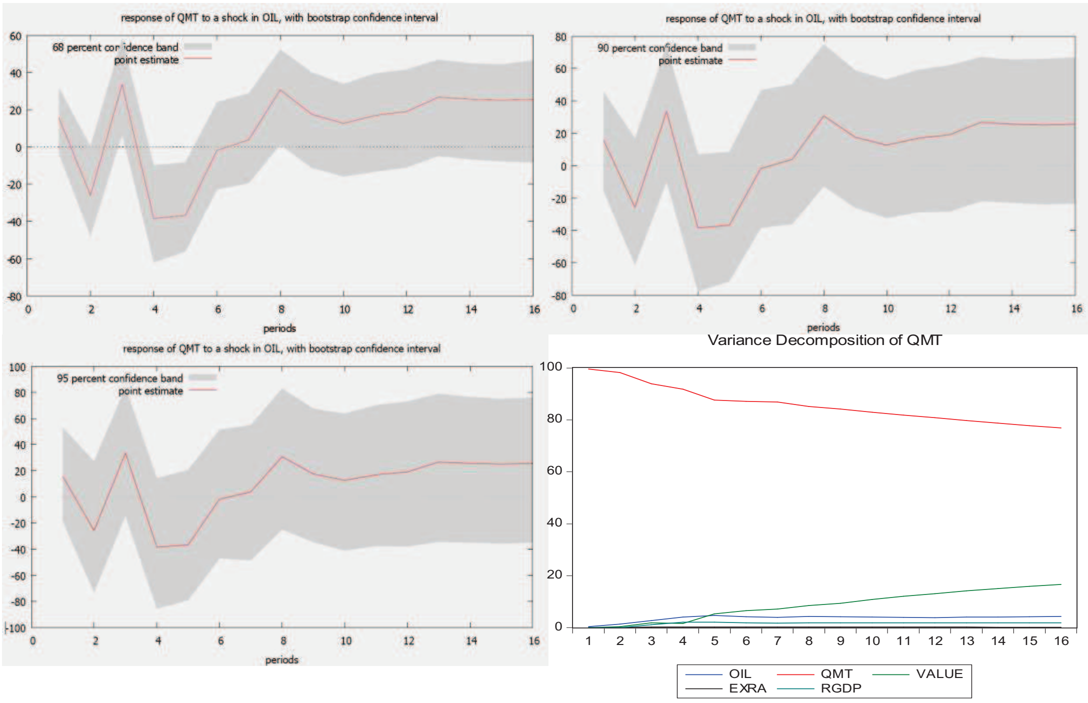
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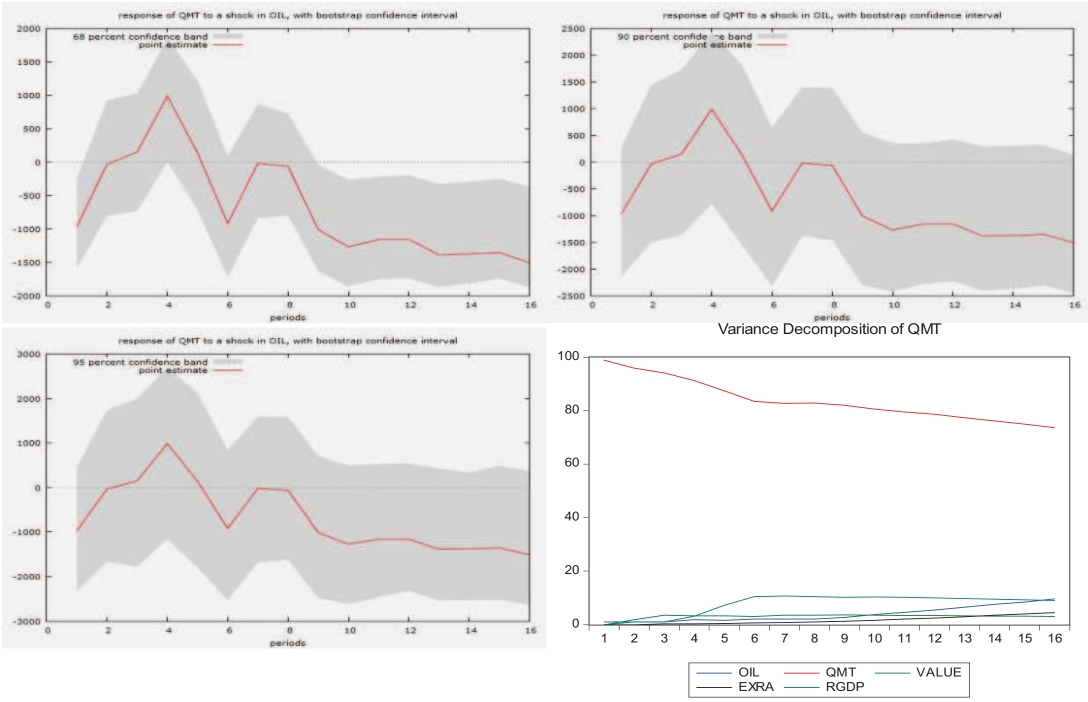
point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
95 percent confidence band
point estimate
periods
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

4.2.5 Africa (South Africa)

1B



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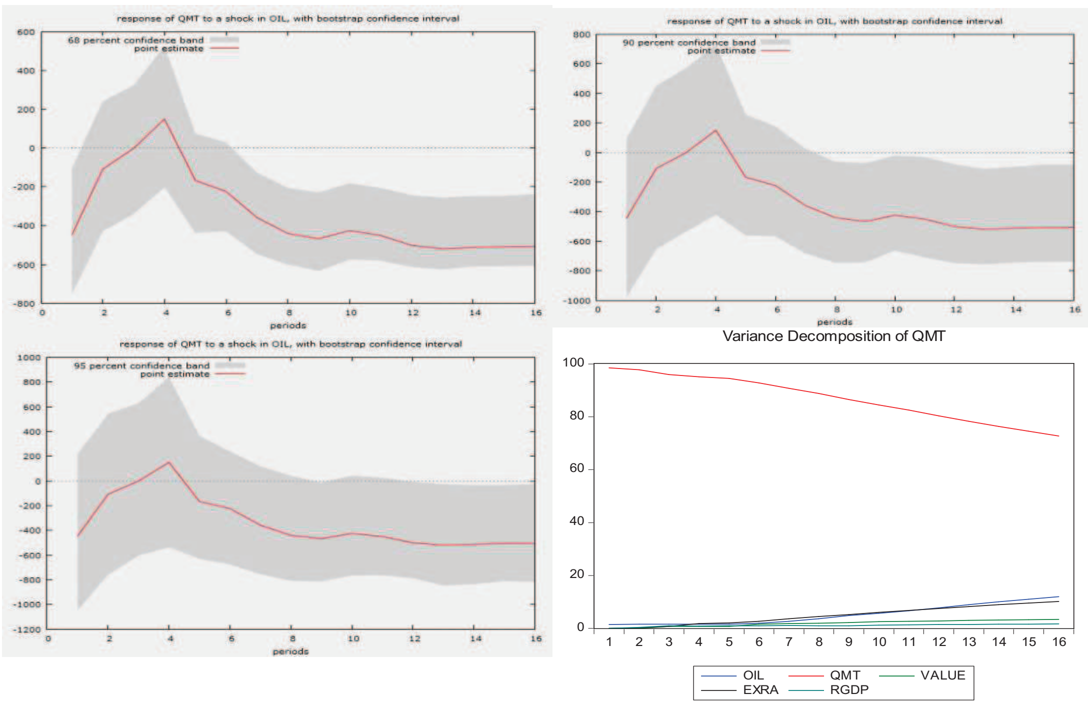

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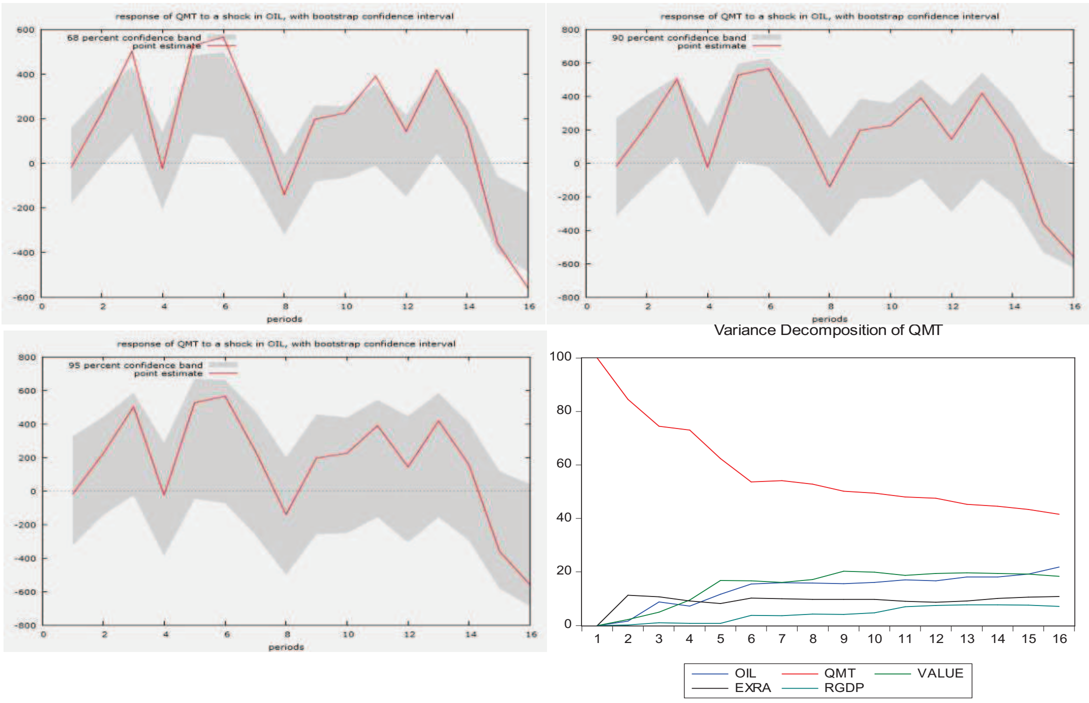
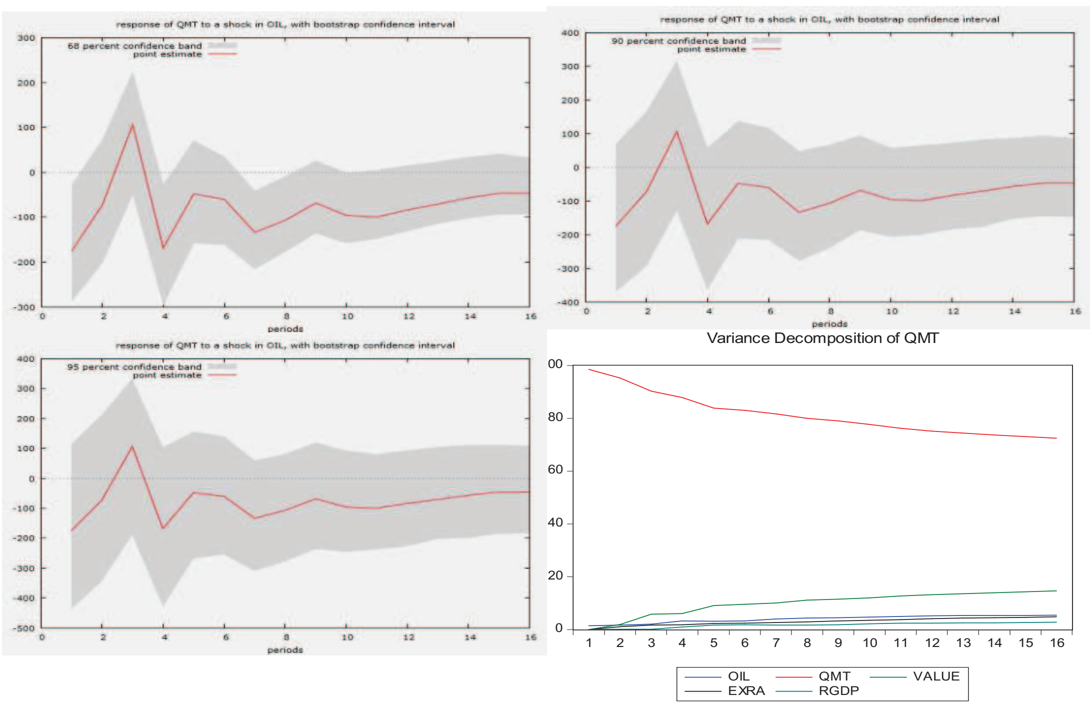
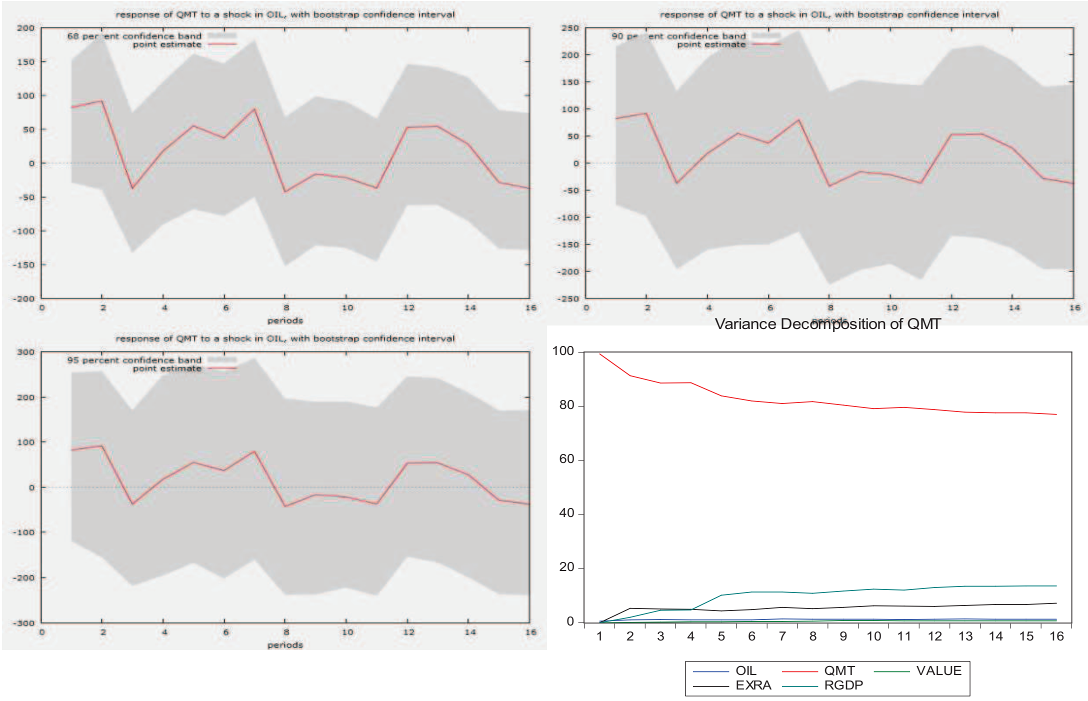

response of QMT to a shock in OIL, with bootstrap confidence interval
68 percent confidence band
point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
90 percent confidence band
point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
95 percent confidence band
point estimate
periods
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

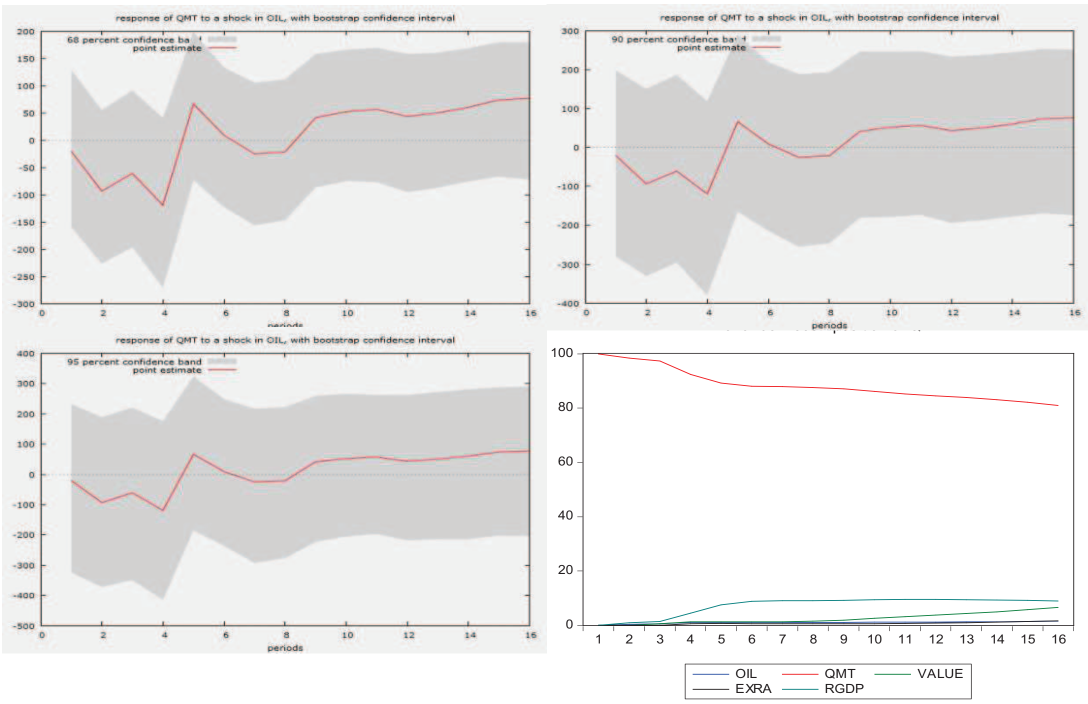
6A


response of QMT to a shock in OIL, with bootstrap confidence interval
68 percent confidence band
point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
90 percent confidence band
point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
95 percent confidence band
point estimate
periods
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

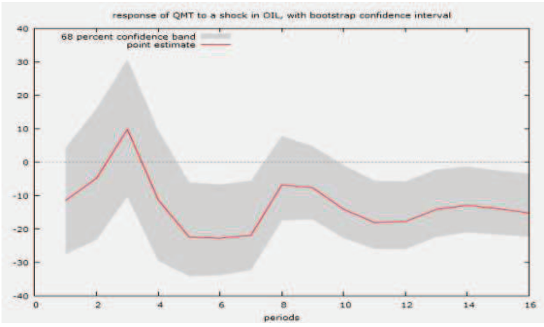
6B

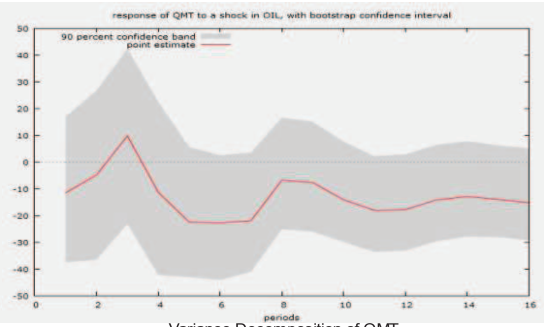

response of QMT to a shock in OIL, with bootstrap confidence interval
68 percent confidence band
point estimate
90 percent confidence band
95 percent confidence band
periods
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

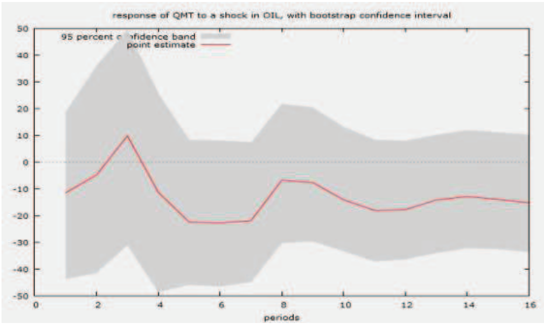
14


response of QMT to a shock in OIL, with bootstrap confidence interval
68 percent confidence band
point estimate
90 percent confidence band
95 percent confidence band
periods
OIL
QMT
VALUE
EXRA
RGDP

16


response of QMT to a shock in OIL, with bootstrap confidence interval
68 percent confidence band
point estimate
periods


response of QMT to a shock in OIL, with bootstrap confidence interval
90 percent confidence band
point estimate
periods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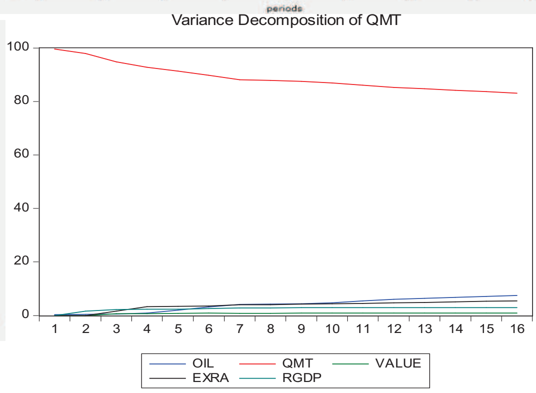
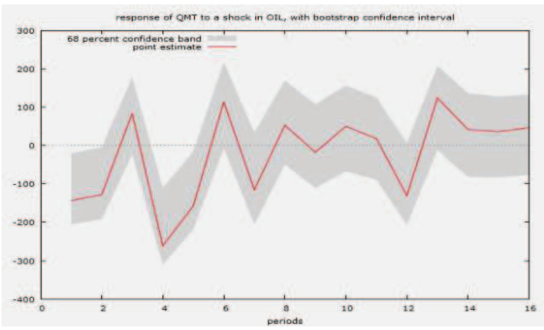
95 percent confidence band
point estimate
periods


Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

18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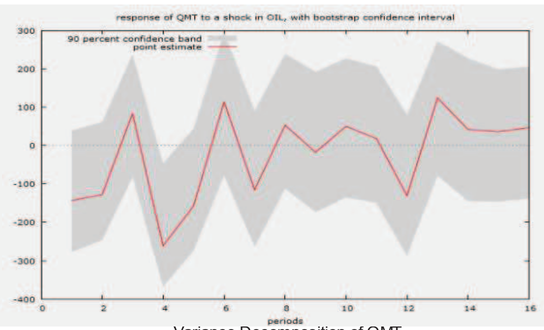
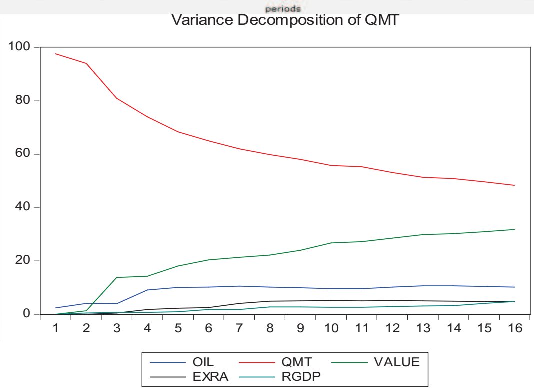
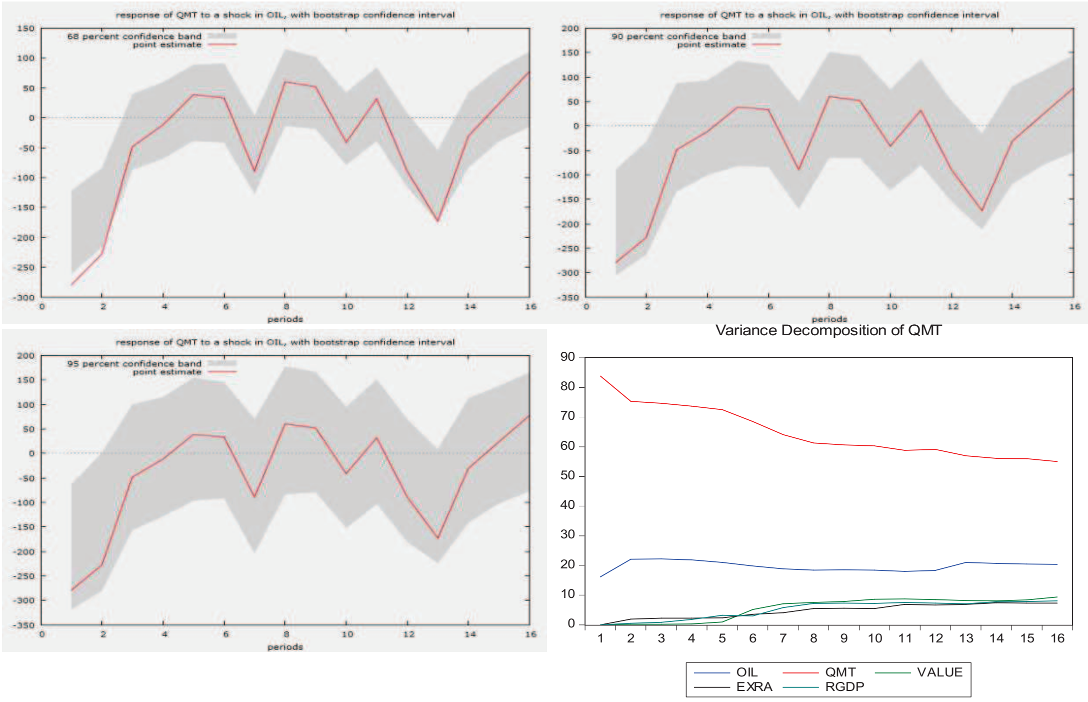
68 percent confidence band
point estimate
periods


response of QMT to a shock in OIL, with bootstrap confidence interval
90 percent confidence band
point estimate
periods


response of QMT to a shock in OIL, with bootstrap confidence interval
95 percent confidence band
point estimate
periods


Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

19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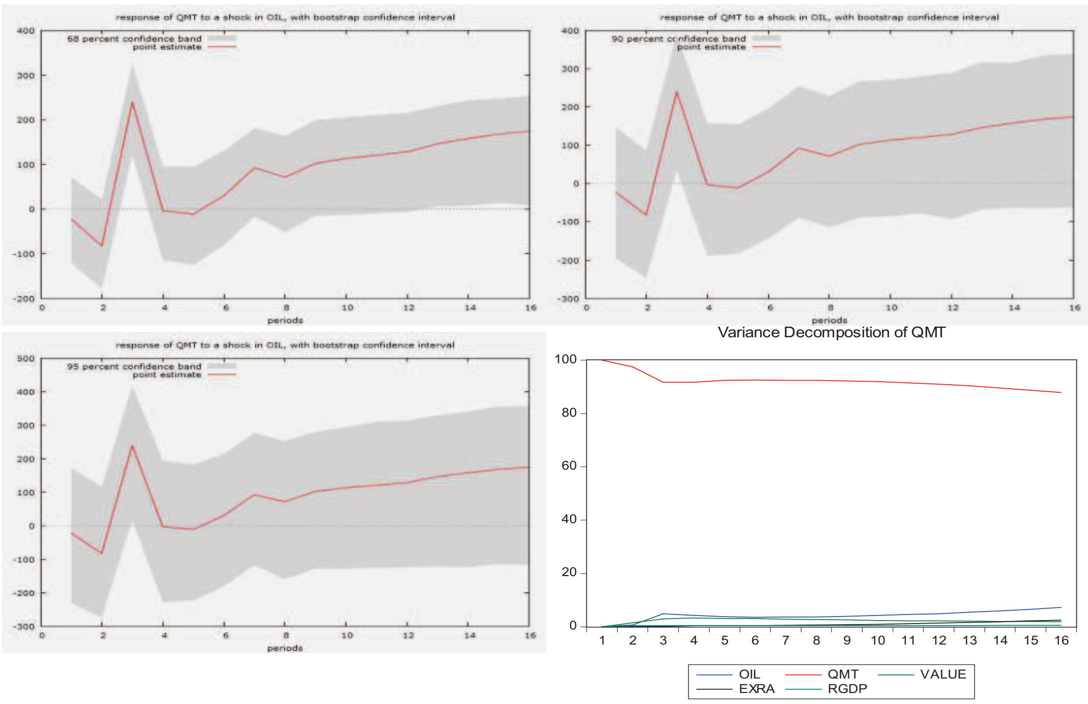
point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
90 percent confidence band
point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
95 percent confidence band
point estimate
periods
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

20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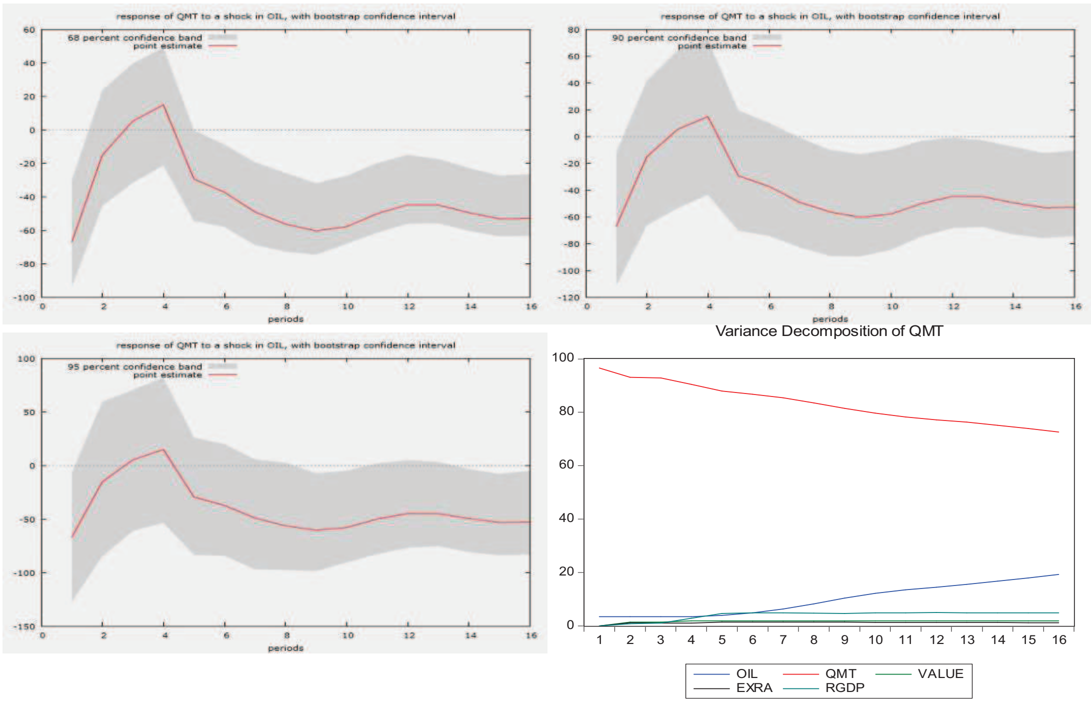
68 percent confidence band
point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
90 percent confidence band
point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
95 percent confidence band
point estimate
periods
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

21A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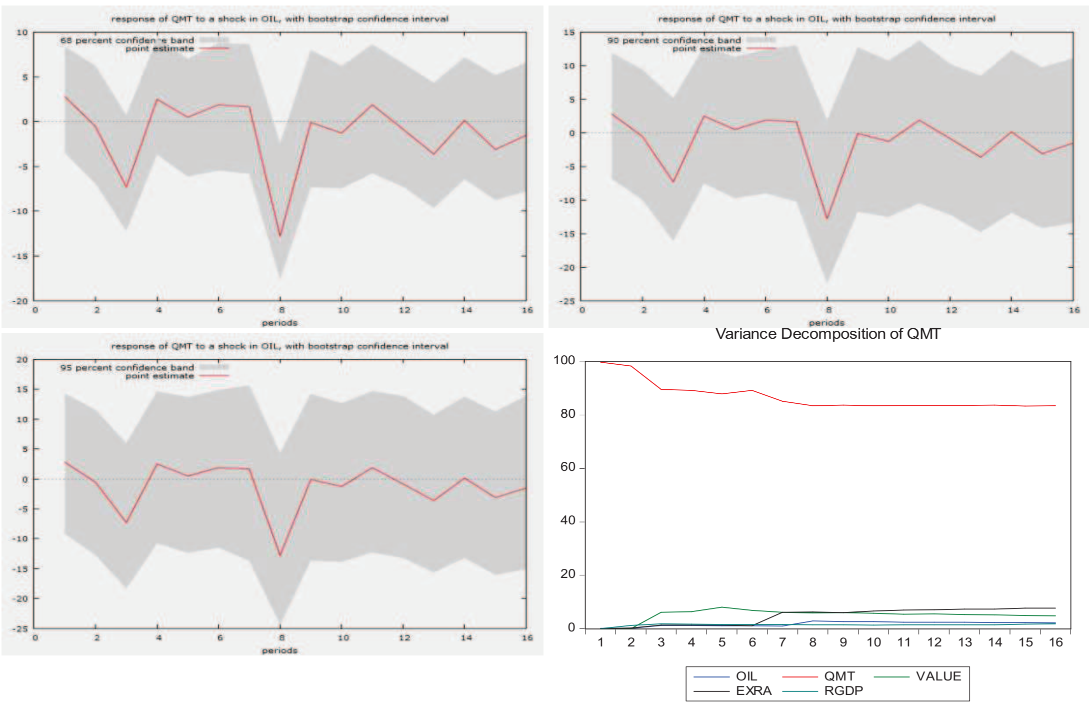
68 percent confidence band
point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
90 percent confidence band
point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
95 percent confidence band
point estimate
periods
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

21CD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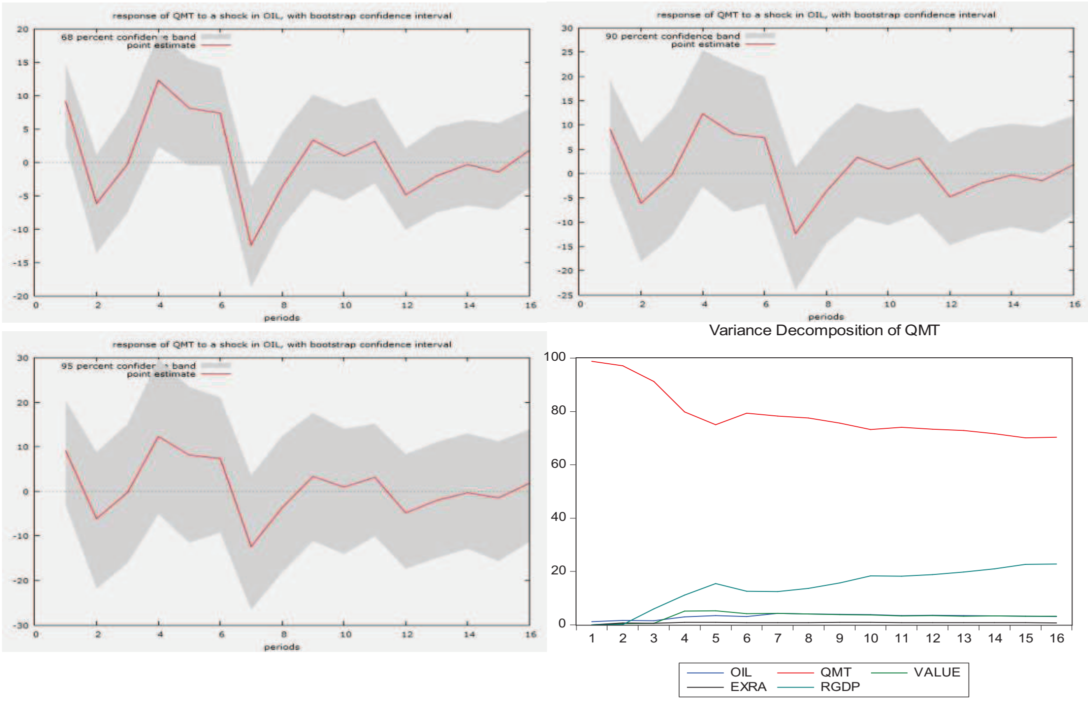
68 percent confidence band
point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
90 percent confidence band
point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
95 percent confidence band
point estimate
periods
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

21E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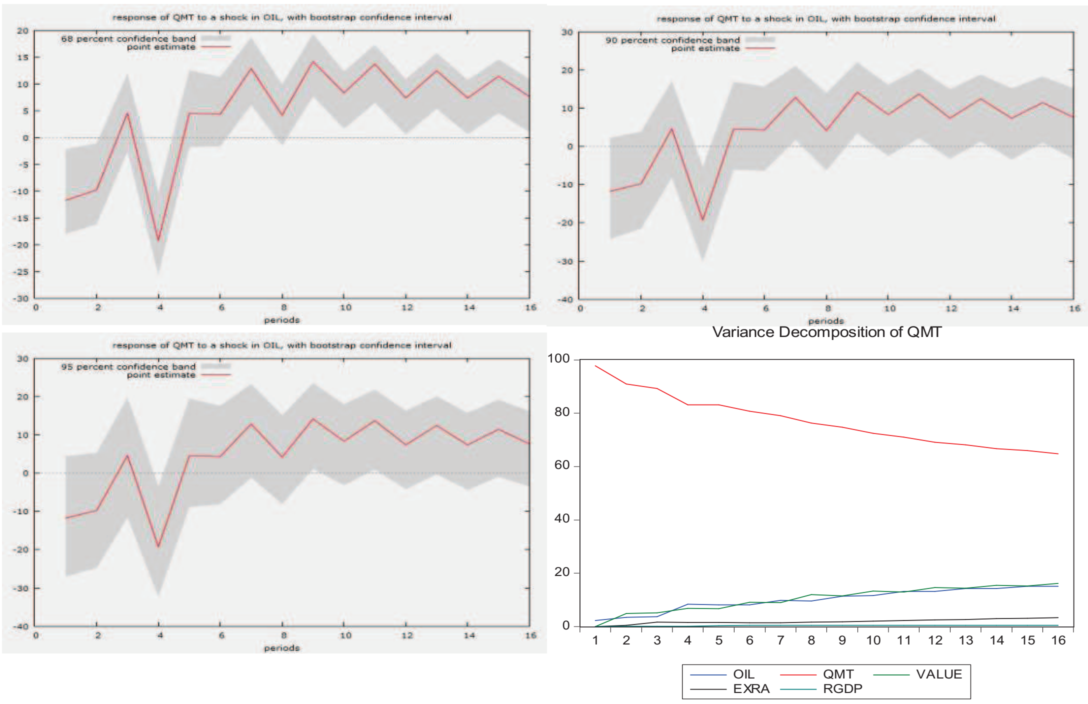
point estimate
periods
90 percent confidence band
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

22A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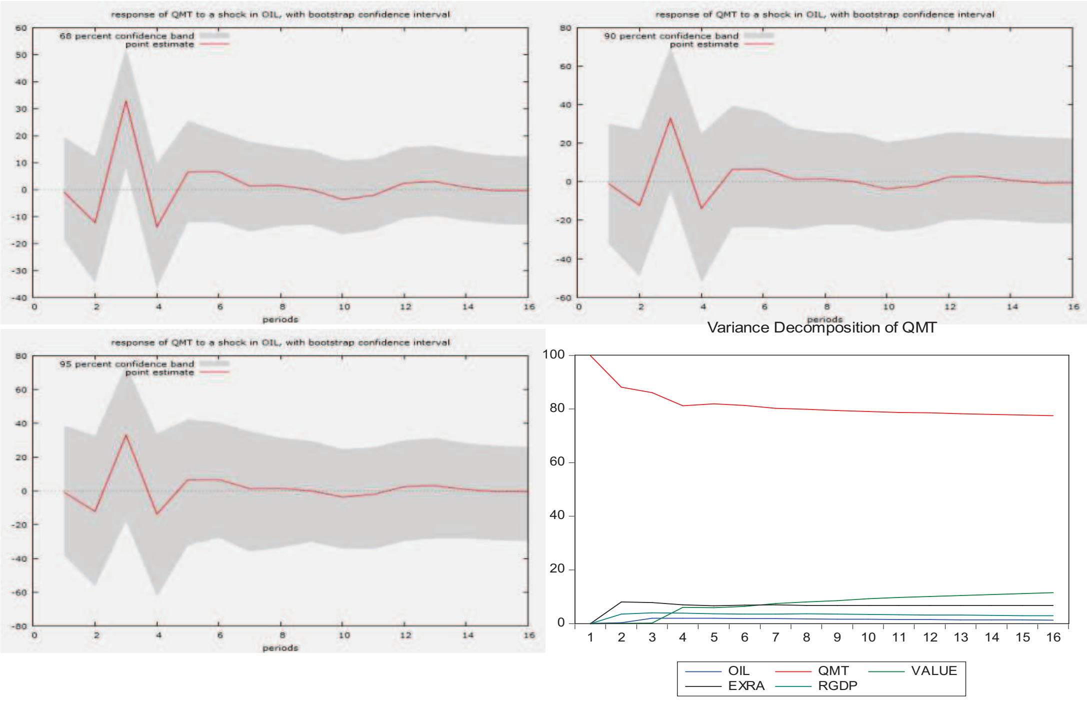
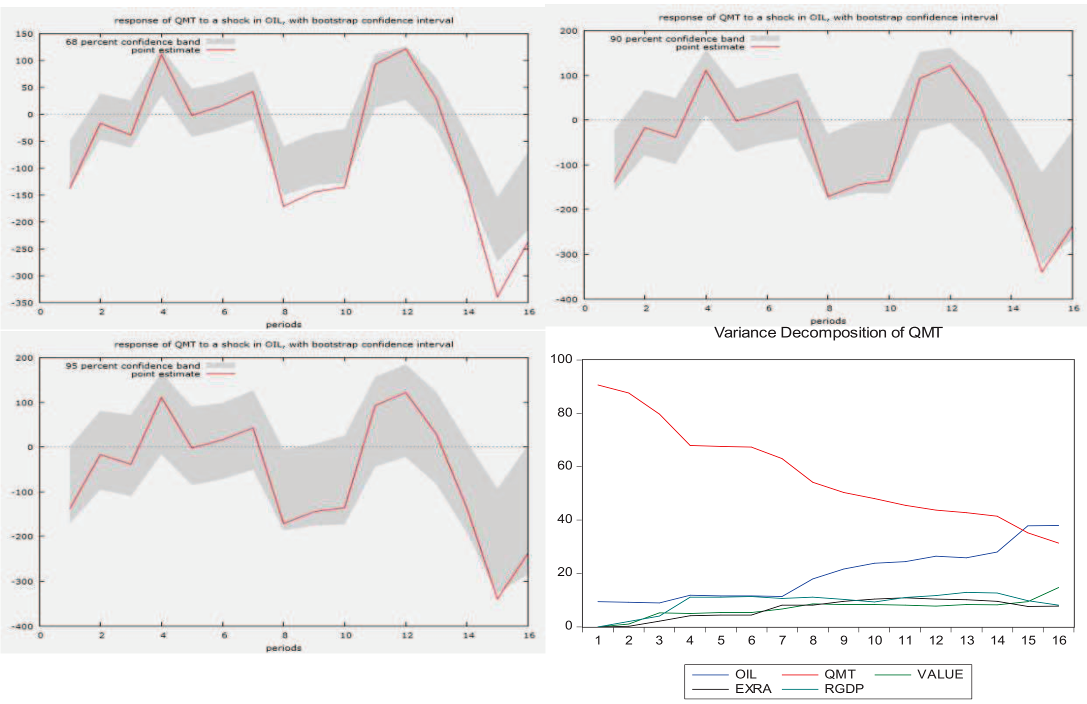
point estimate
periods
90 percent confidence band
95 percent confidence band
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

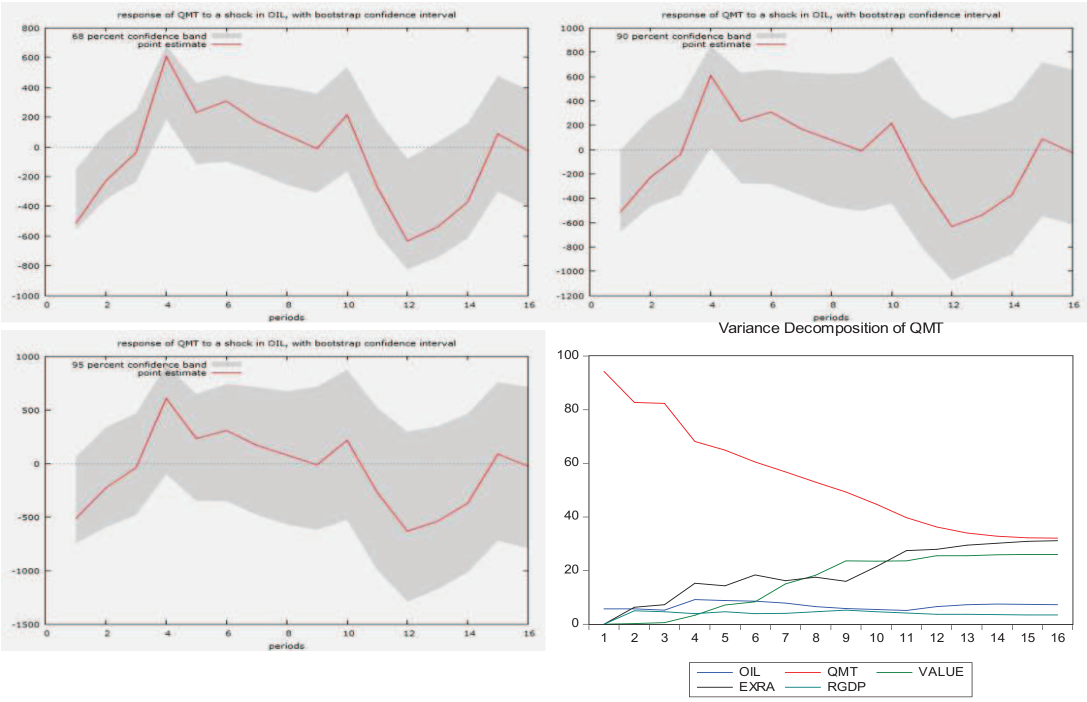
22B


response of QMT to a shock in OIL, with bootstrap confidence interval
68 percent confidence band
point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
90 percent confidence band
point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
95 percent confidence band
point estimate
periods
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

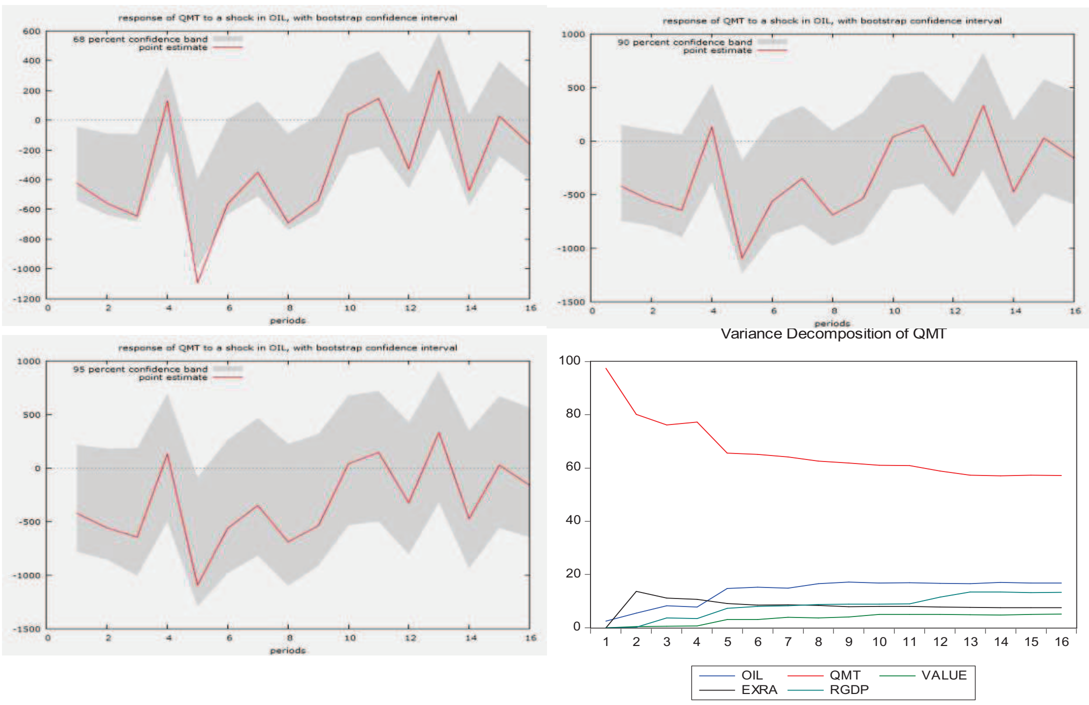
23


response of QMT to a shock in OIL, with bootstrap confidence interval
68 percent confidence band
point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
90 percent confidence band
point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
95 percent confidence band
point estimate
periods
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

31


response of QMT to a shock in OIL, with bootstrap confidence interval
68 percent confidence band
point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
90 percent confidence band
point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
95 percent confidence band
point estimate
periods
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

32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68 percent confidence band
point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
90 percent confidence band
point estimate
periods
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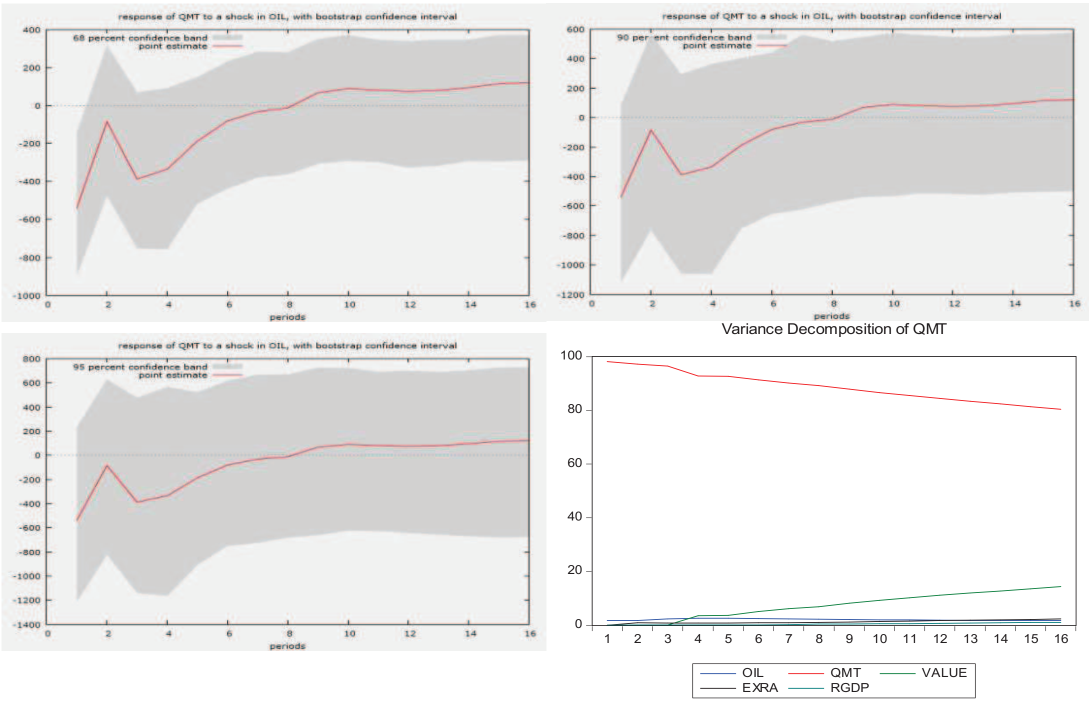
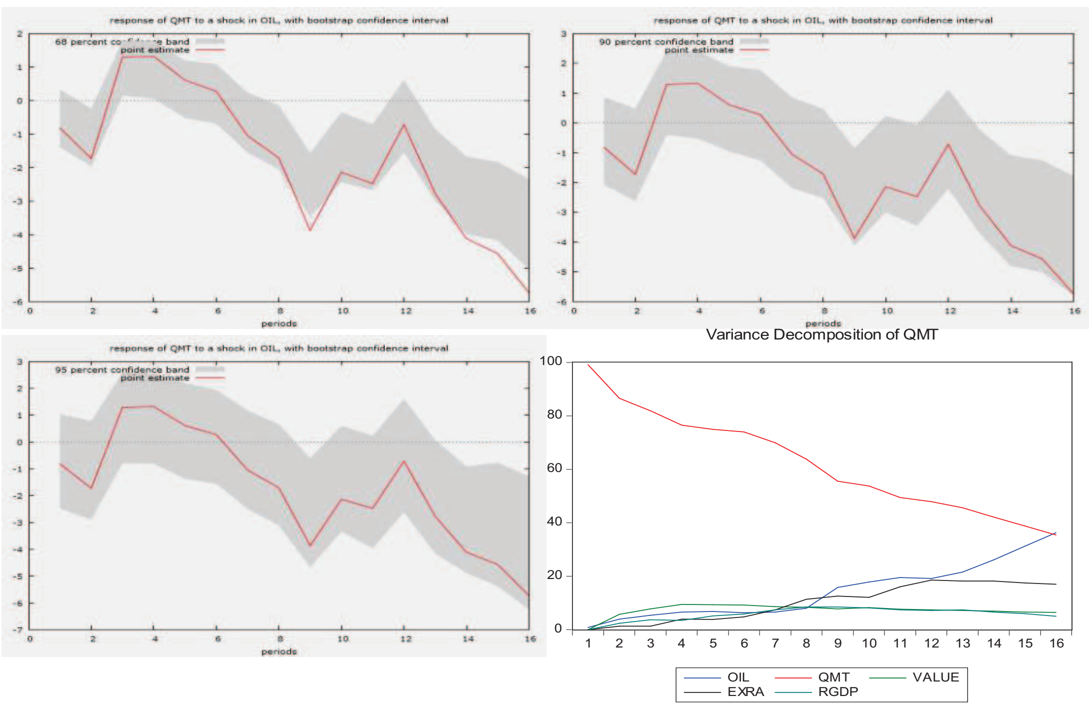
95 percent confidence band
point estimate
periods
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

33A


response of QMT to a shock in OIL, with bootstrap confidence interval
68 percent confidence band
point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
90 percent confidence band
point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
95 percent confidence band
point estimate
periods
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

37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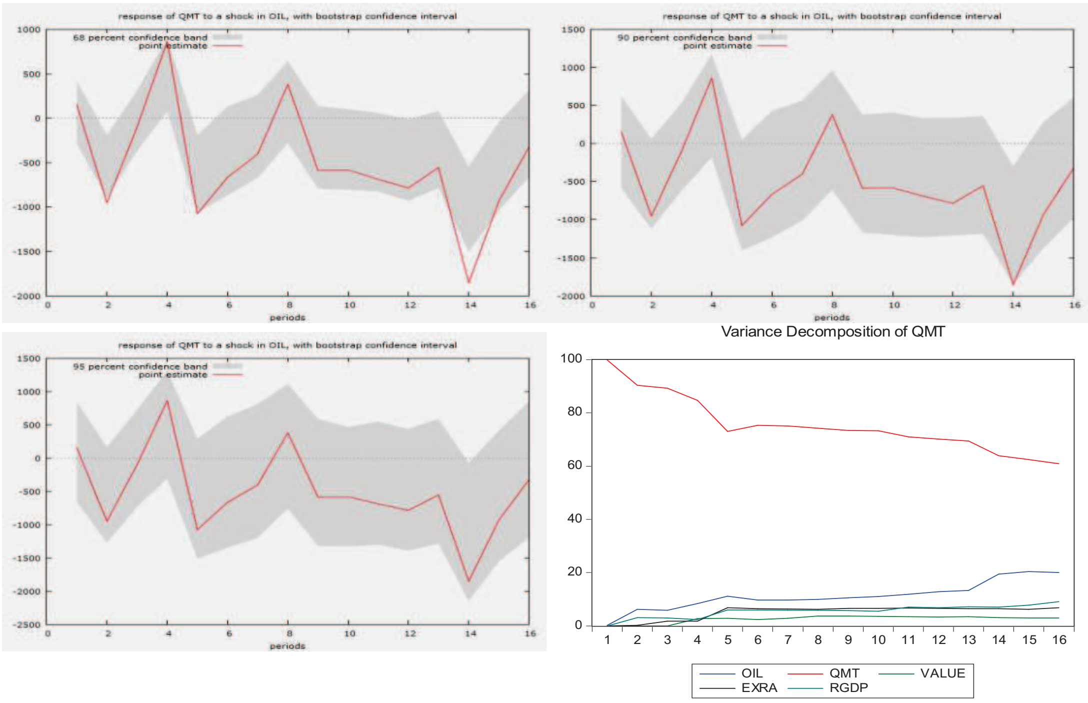
point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
90 percent confidence band
point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
95 percent confidence band
point estimate
periods
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

4.2.6 Middle East (Turkey)

1B



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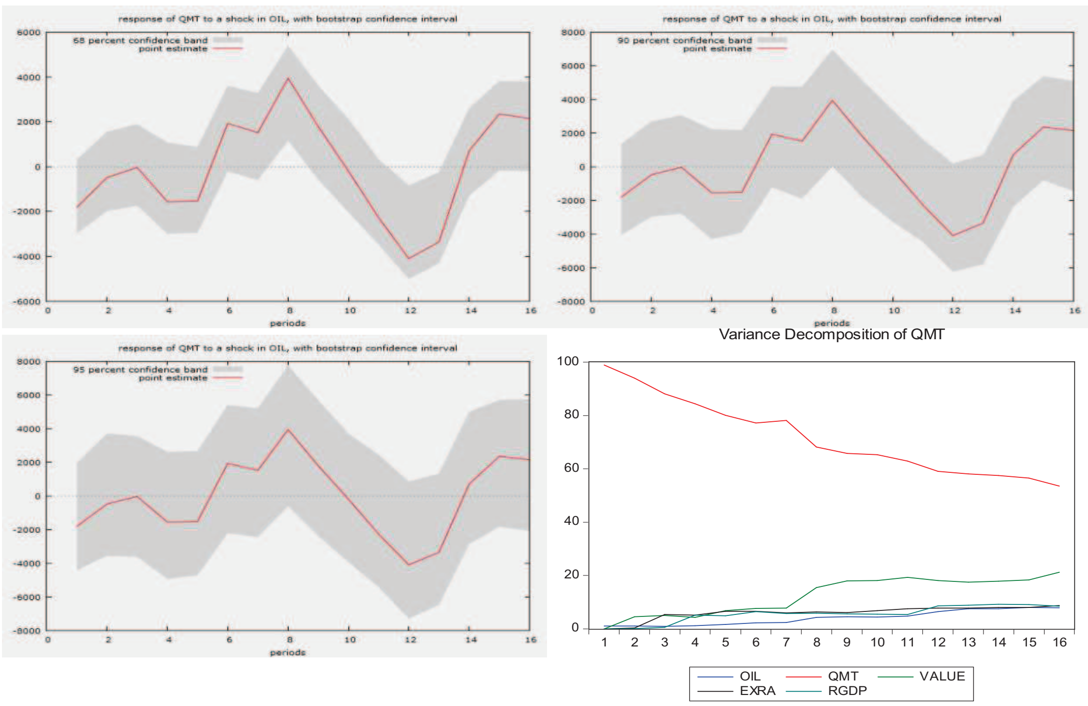

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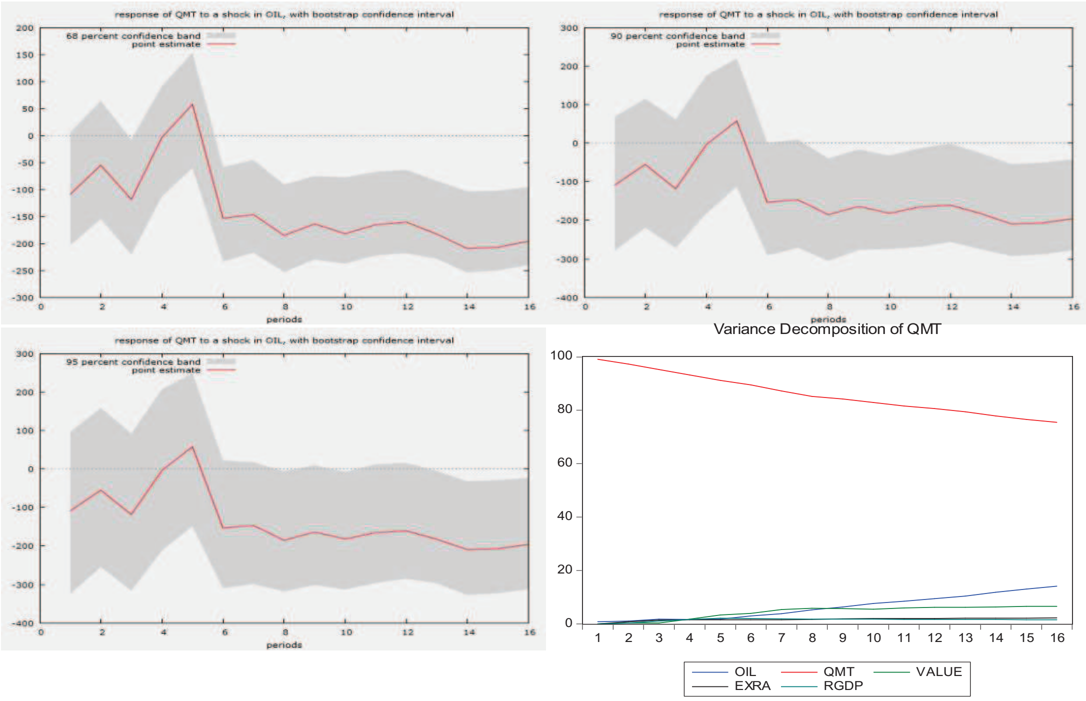
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68 percent confidence band
point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
90 percent confidence band
point estimate
periods
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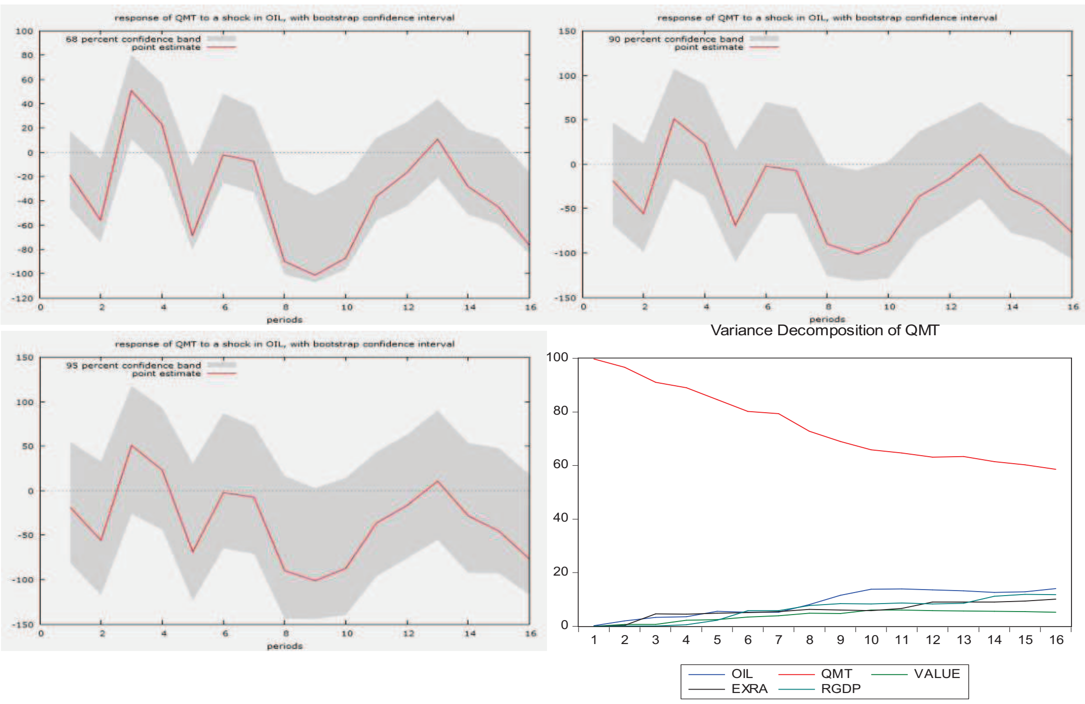
95 percent confidence band
point estimate
periods
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

6A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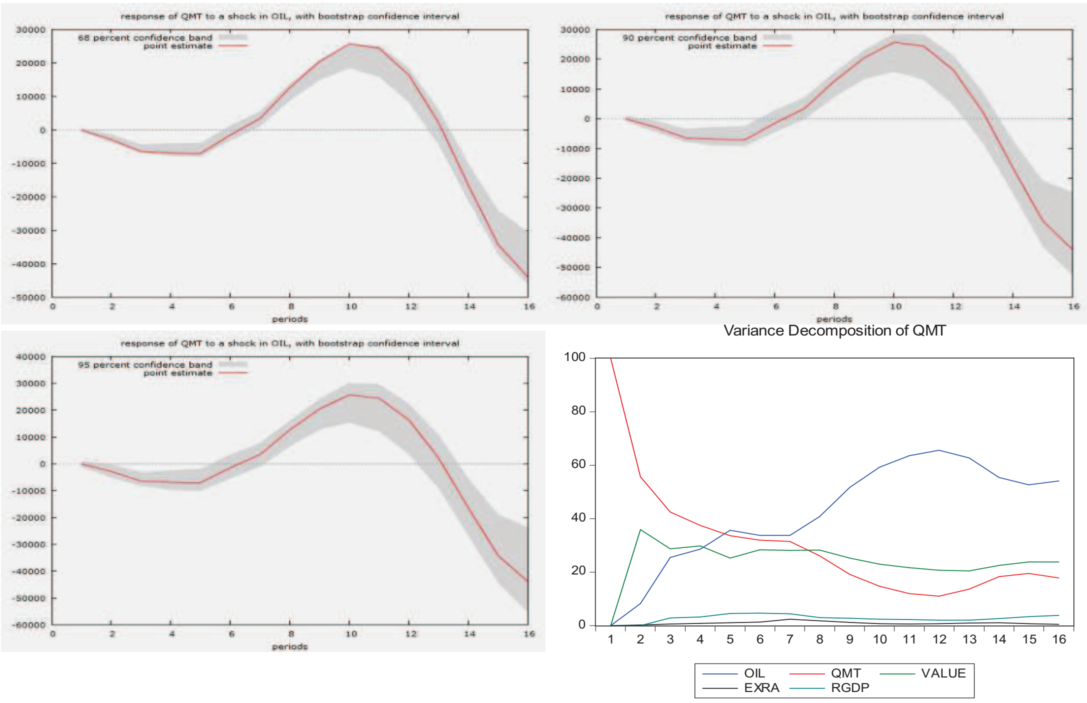
point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
90 percent confidence band
point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
95 percent confidence band
point estimate
periods
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

6B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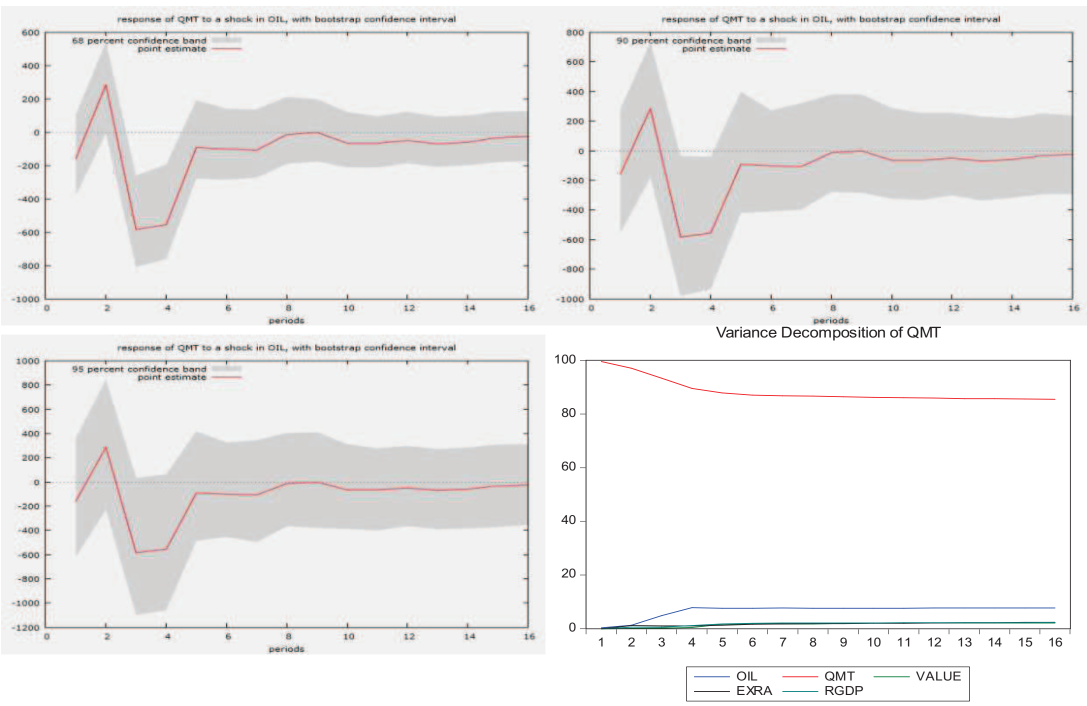
point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
90 percent confidence band
point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
95 percent confidence band
point estimate
periods
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

14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68 percent confidence band
point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
90 percent confidence band
point estimate
periods
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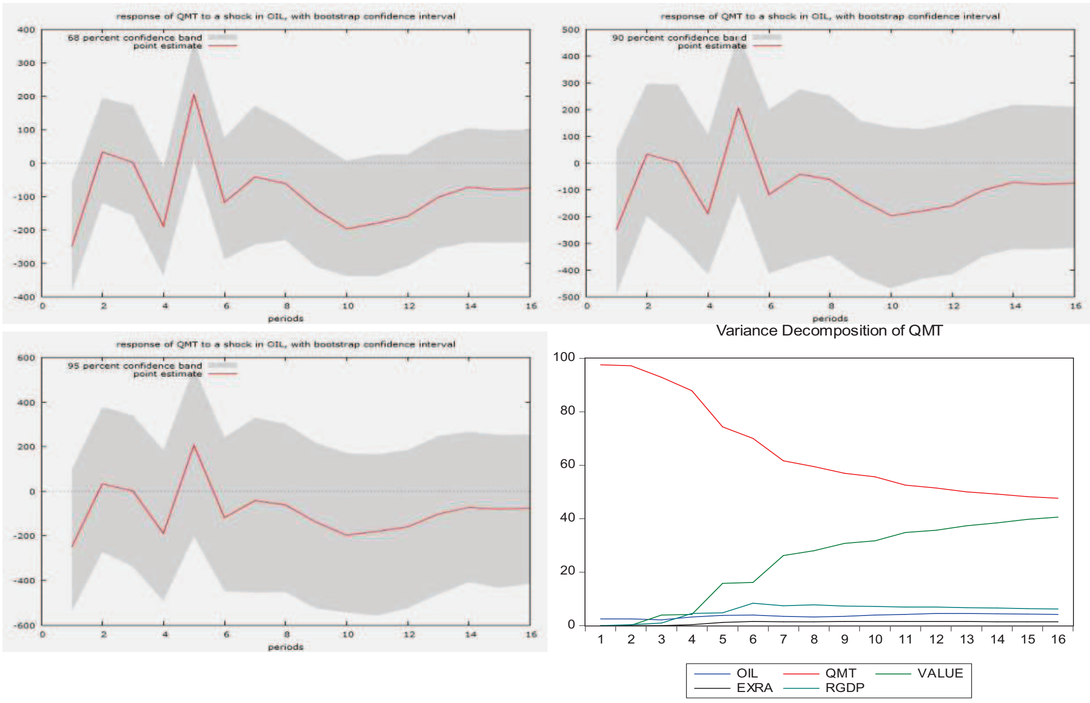
95 percent confidence band
point estimate
periods
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

14A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point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
90 percent confidence band
point estimate
periods
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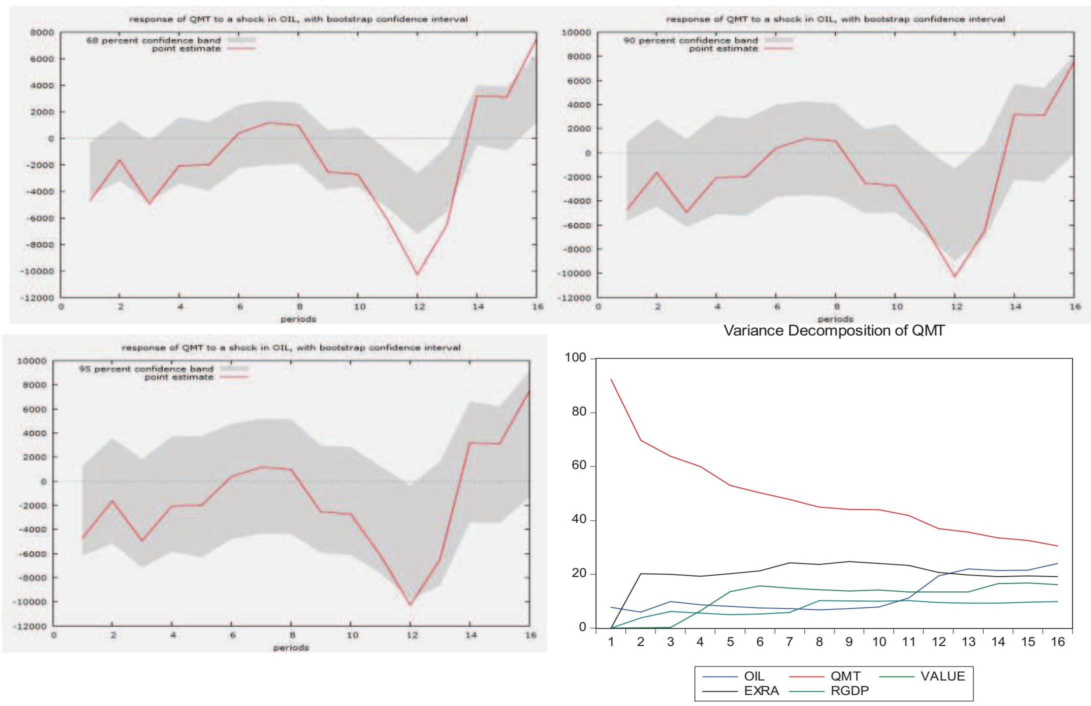
95 percent confidence band
point estimate
periods
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

15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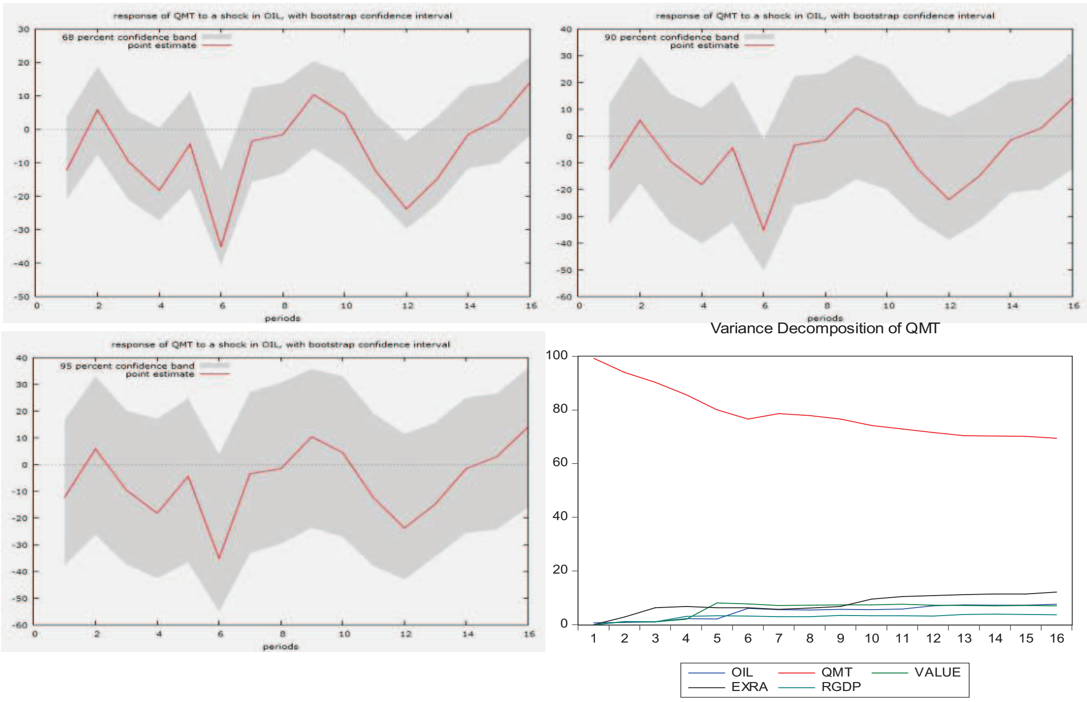
68 percent confidence band
point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
90 percent confidence band
point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
95 percent confidence band
point estimate
periods
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

16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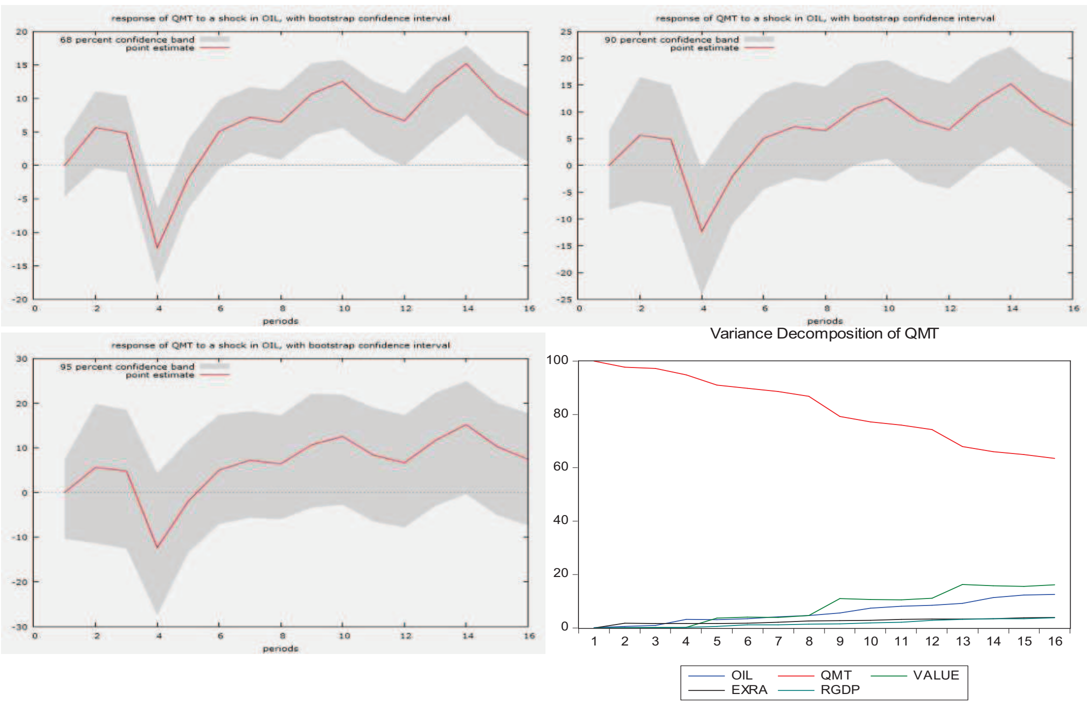
68 percent confidence band
point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
90 percent confidence band
point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
95 percent confidence band
point estimate
periods
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

17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periods
response of QMT to a shock in OIL, with bootstrap confidence interval
90 percent confidence band
point estimate
periods
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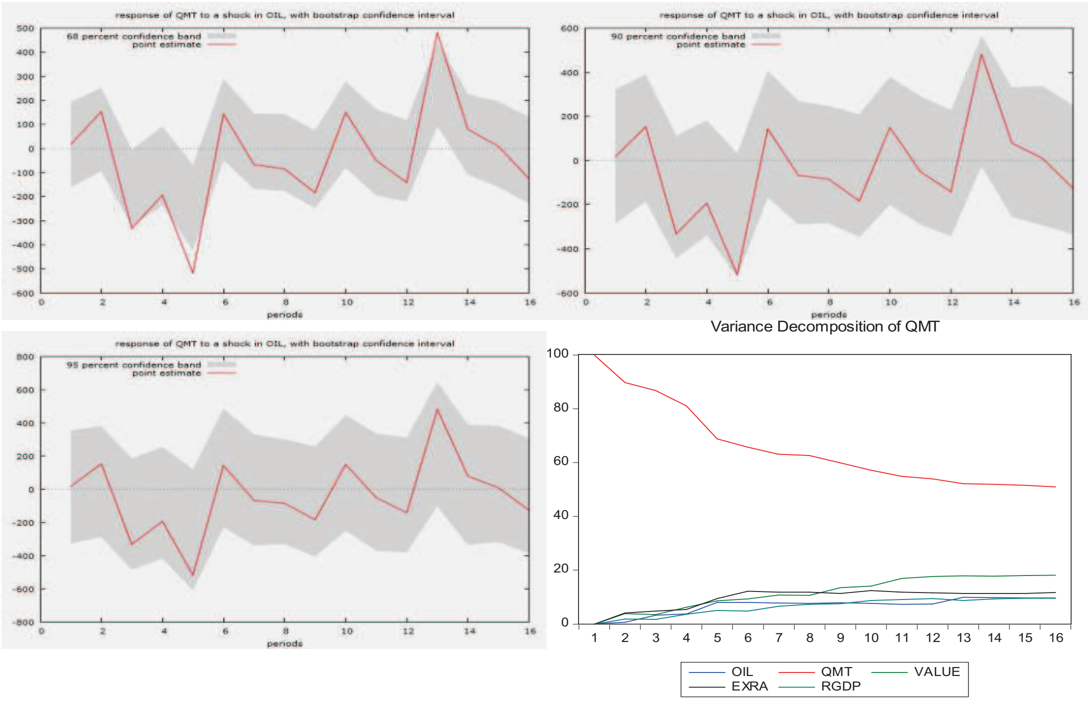
95 percent confidence band
point estimate
periods
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

18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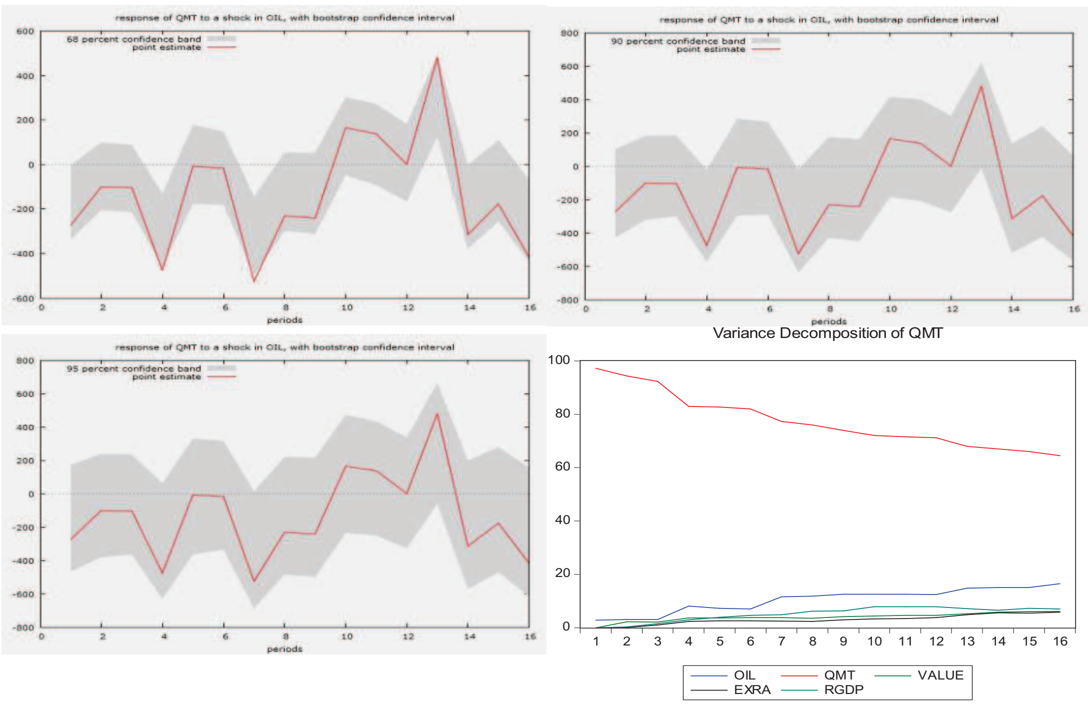
68 percent confidence band
point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
90 percent confidence band
point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
95 percent confidence band
point estimate
periods
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

19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periods
response of QMT to a shock in OIL, with bootstrap confidence interval
90 percent confidence band
point estimate
periods
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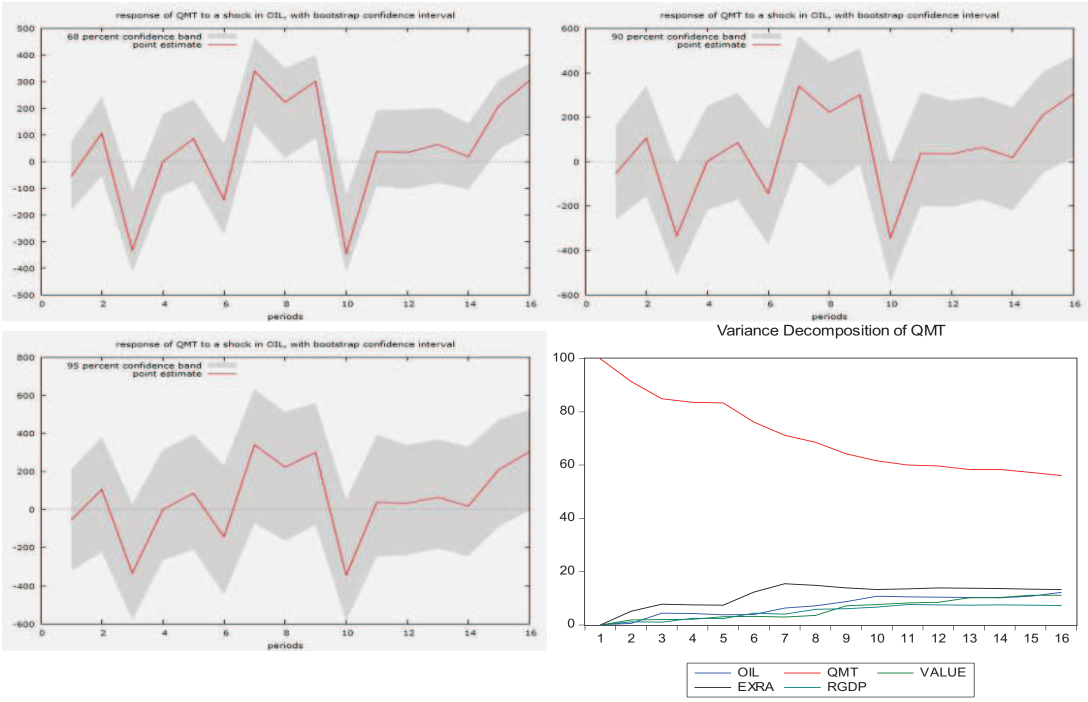
95 percent confidence band
point estimate
periods
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

21A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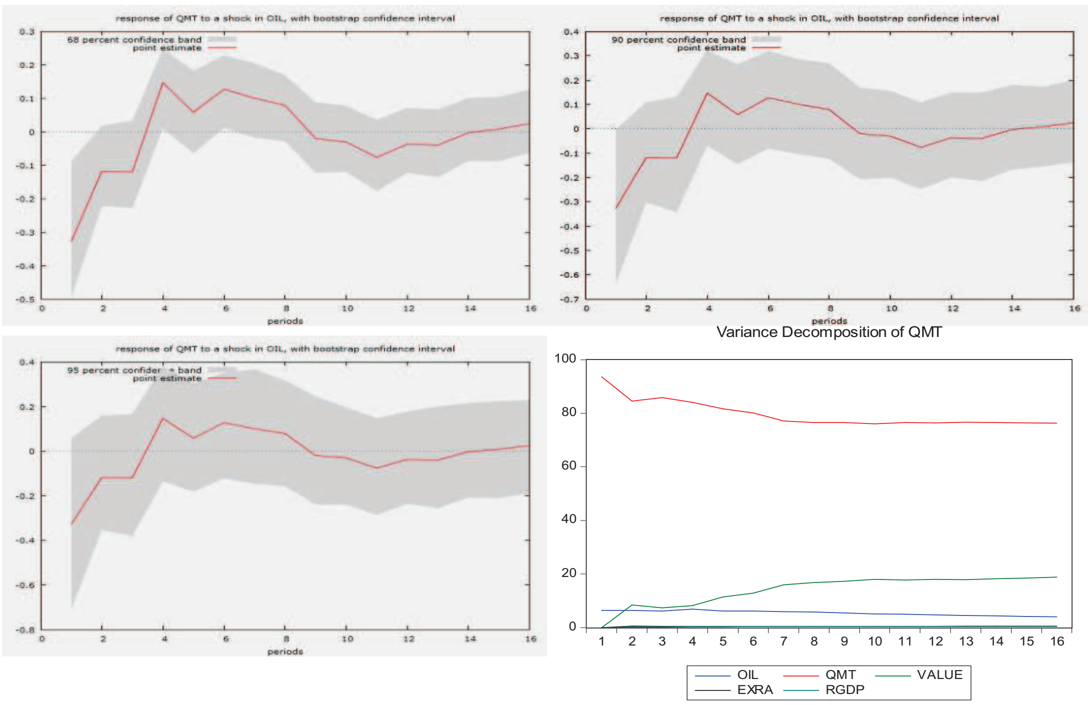
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
90 percent confidence band
point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
95 percent confidence band
point estimate
periods
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

21B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point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
90 percent confidence band
point estimate
periods
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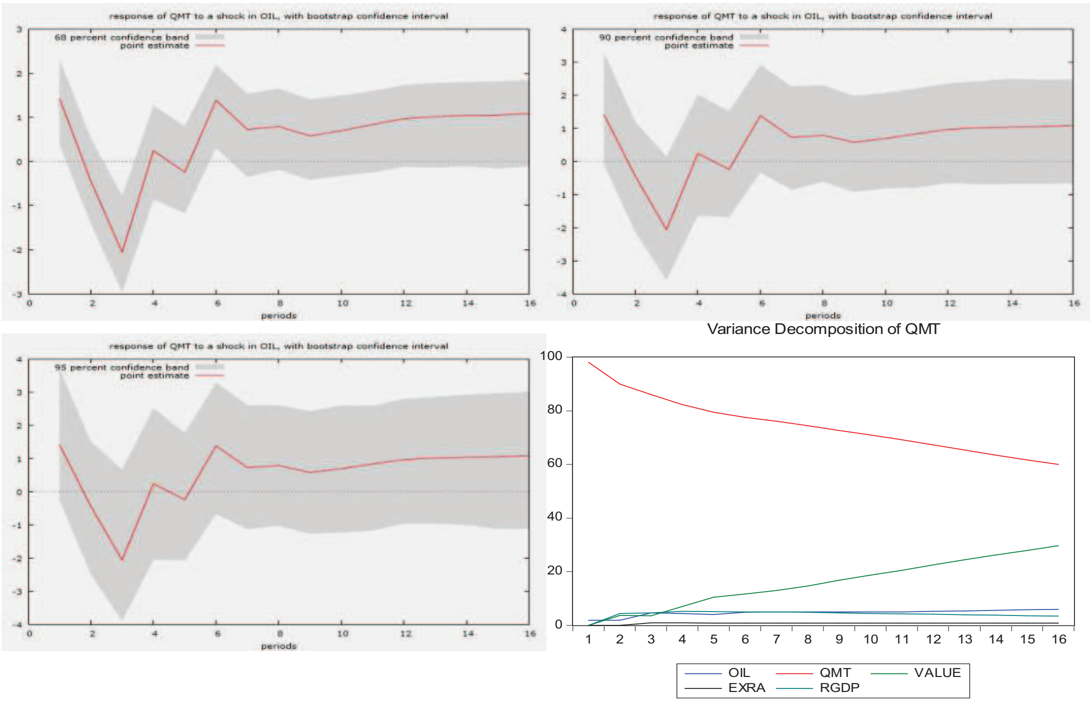
point estimate
periods
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

21CD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periods
response of QMT to a shock in OIL, with bootstrap confidence interval
90 percent confidence band
point estimate
periods
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point estimate
periods
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

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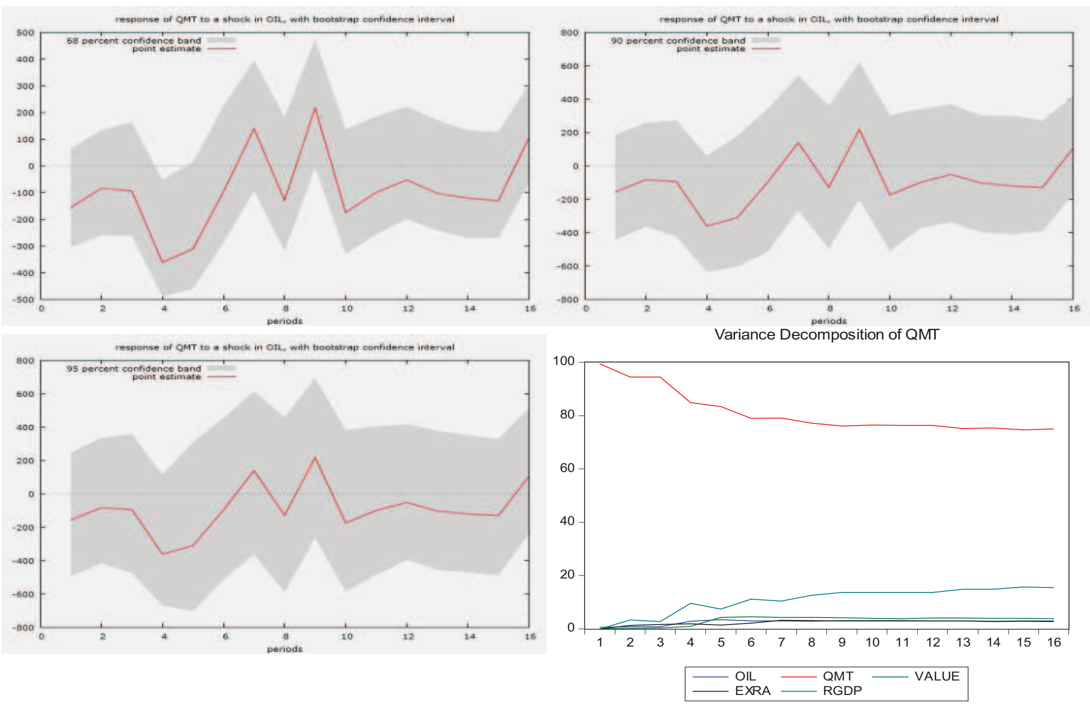
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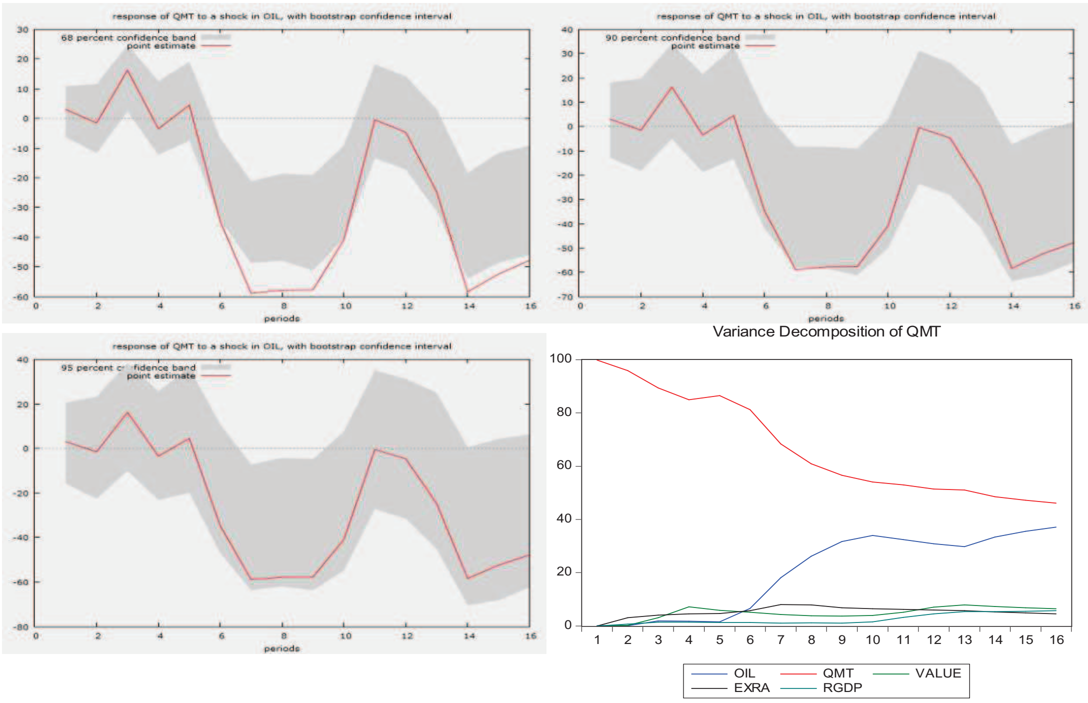
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
90 percent confidence band
point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
95 percent confidence band
point estimate
periods
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

23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point estimate
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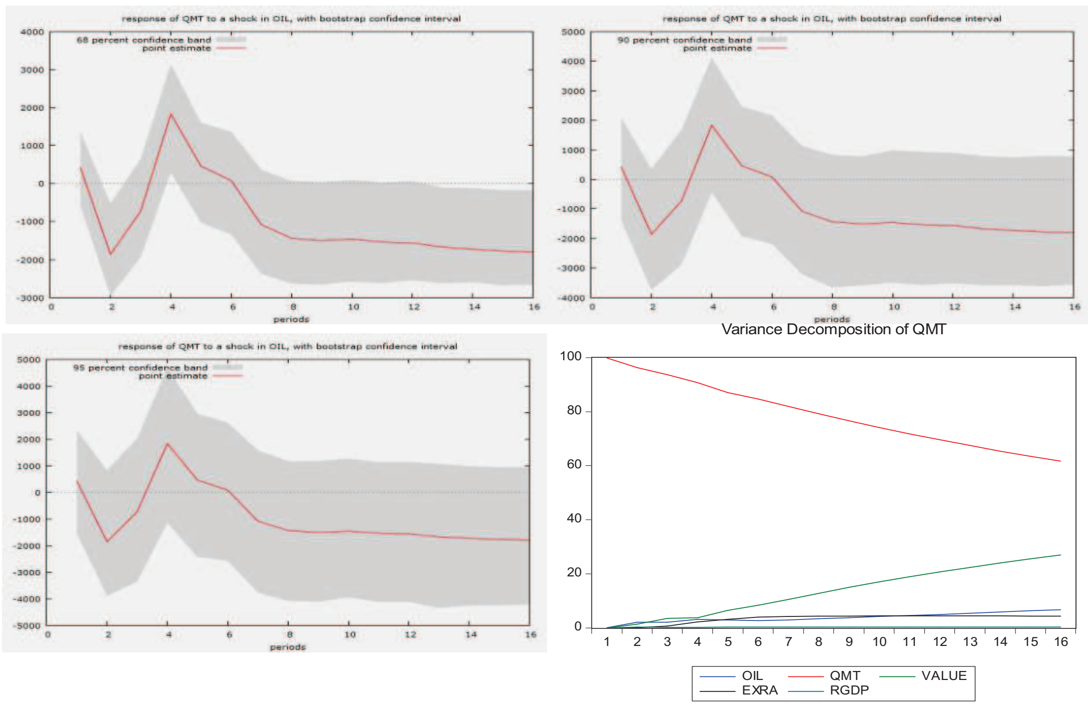
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Variance Decomposition of QMT
OIL
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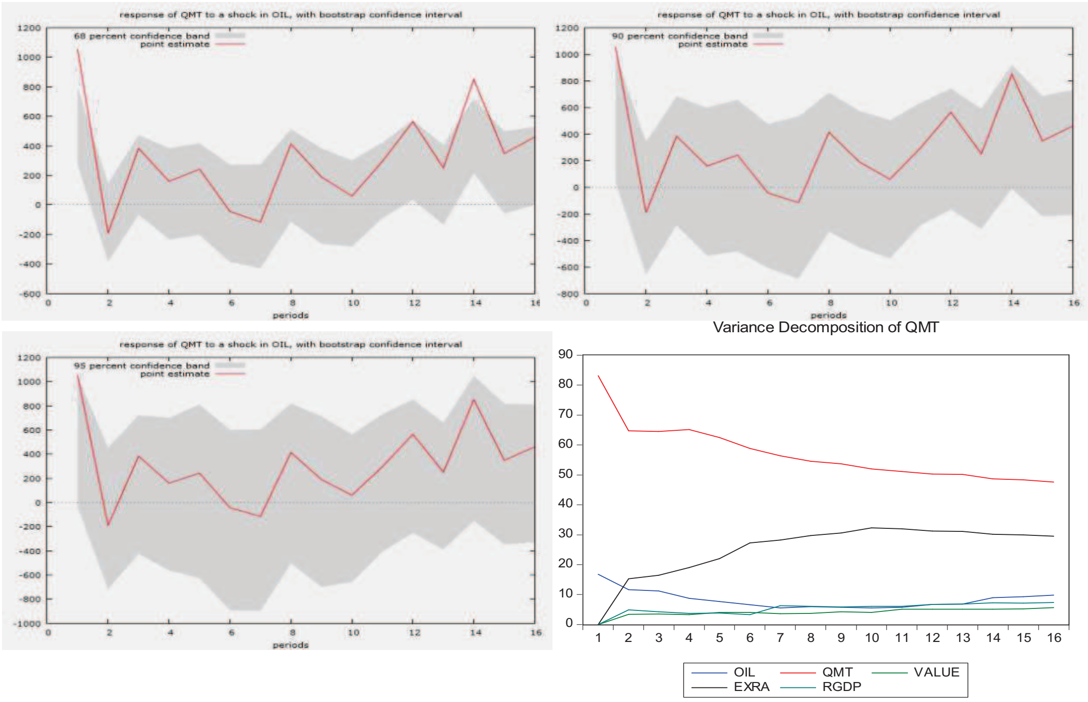
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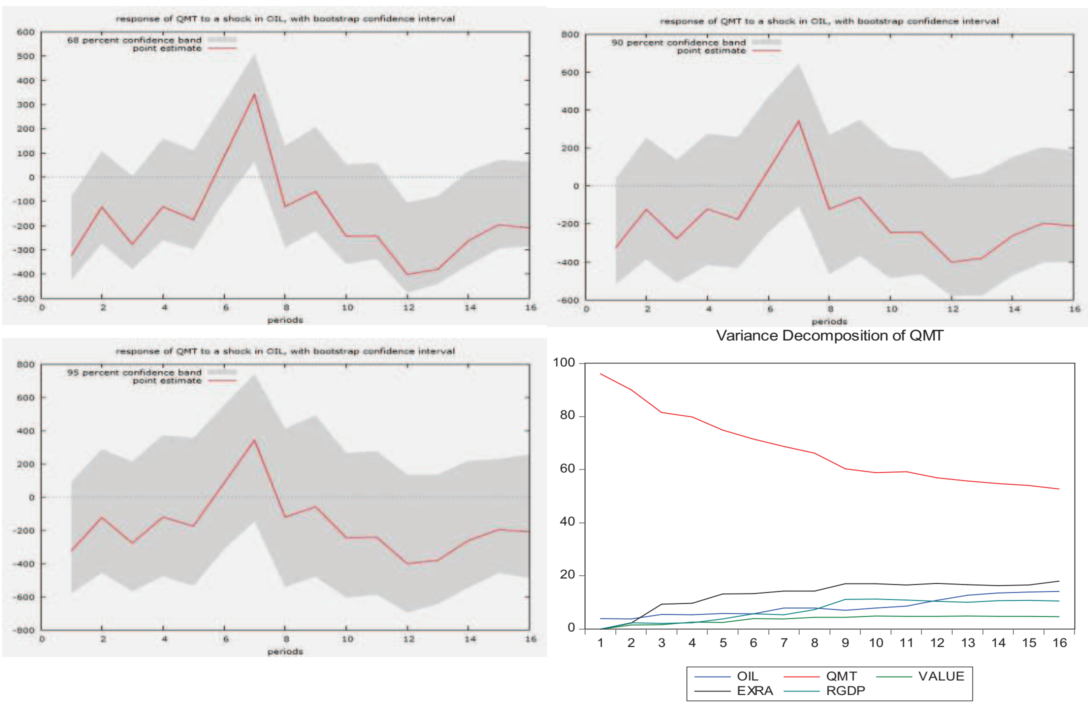
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RGDP

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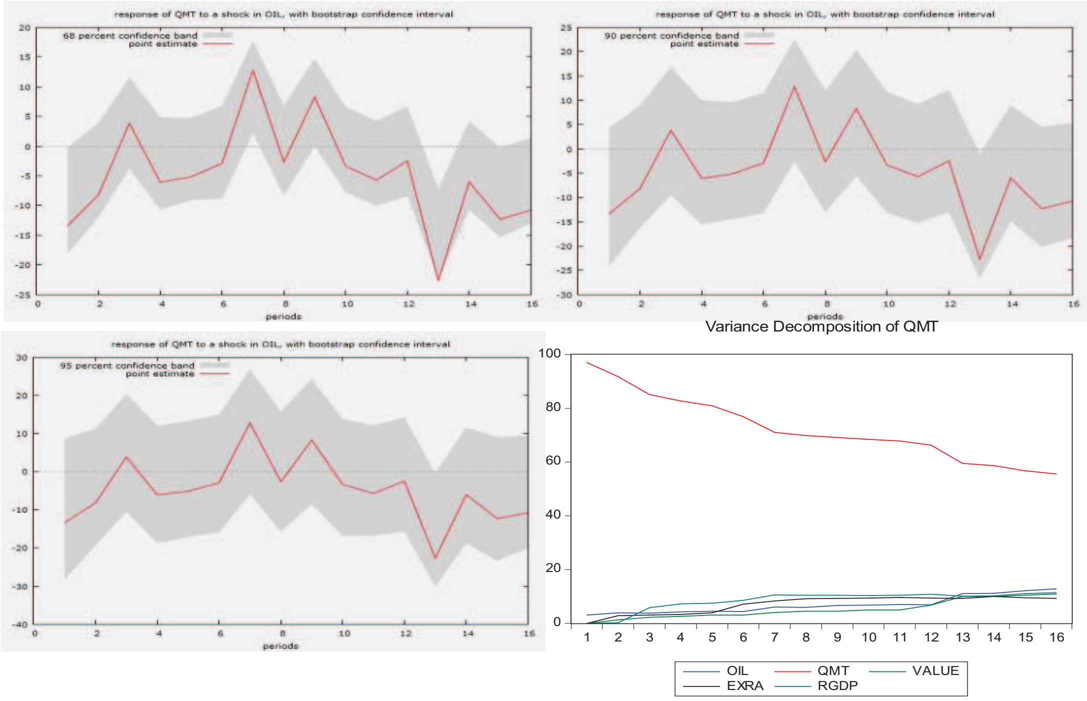
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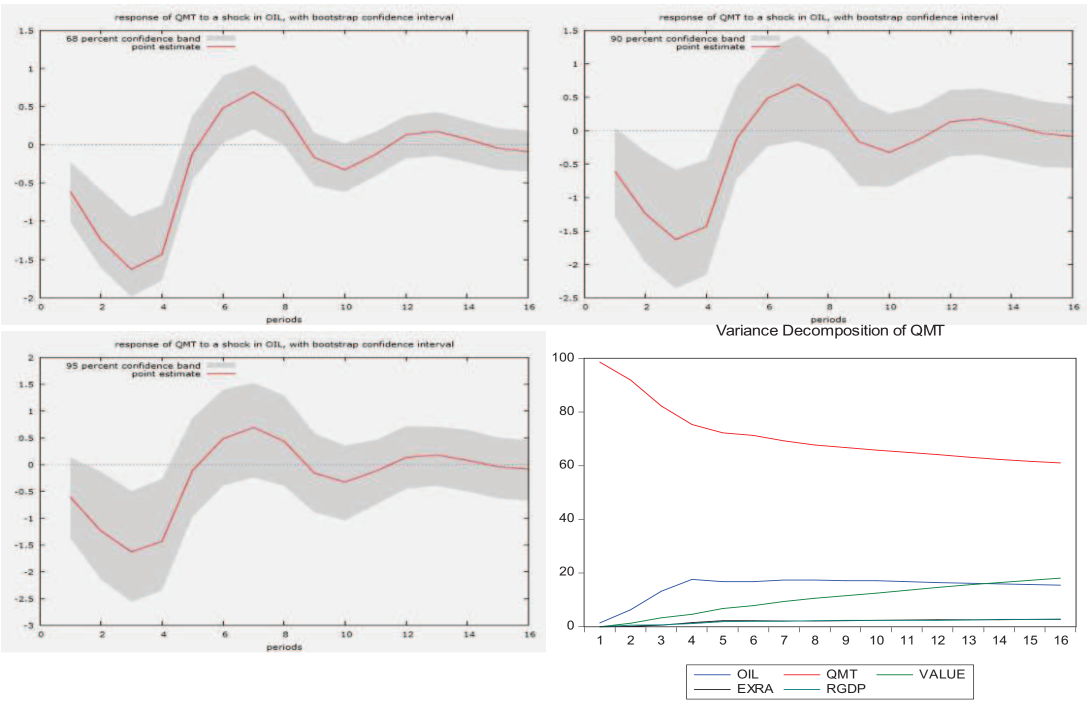
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4.2.7 Asia

4.2.7.1 China

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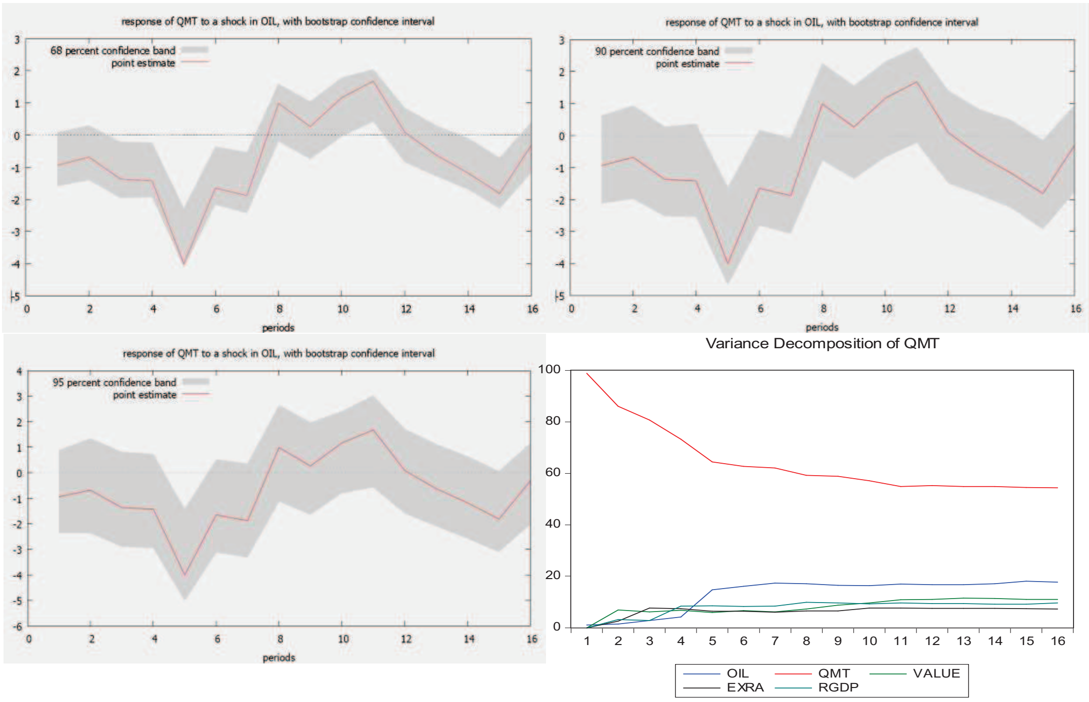

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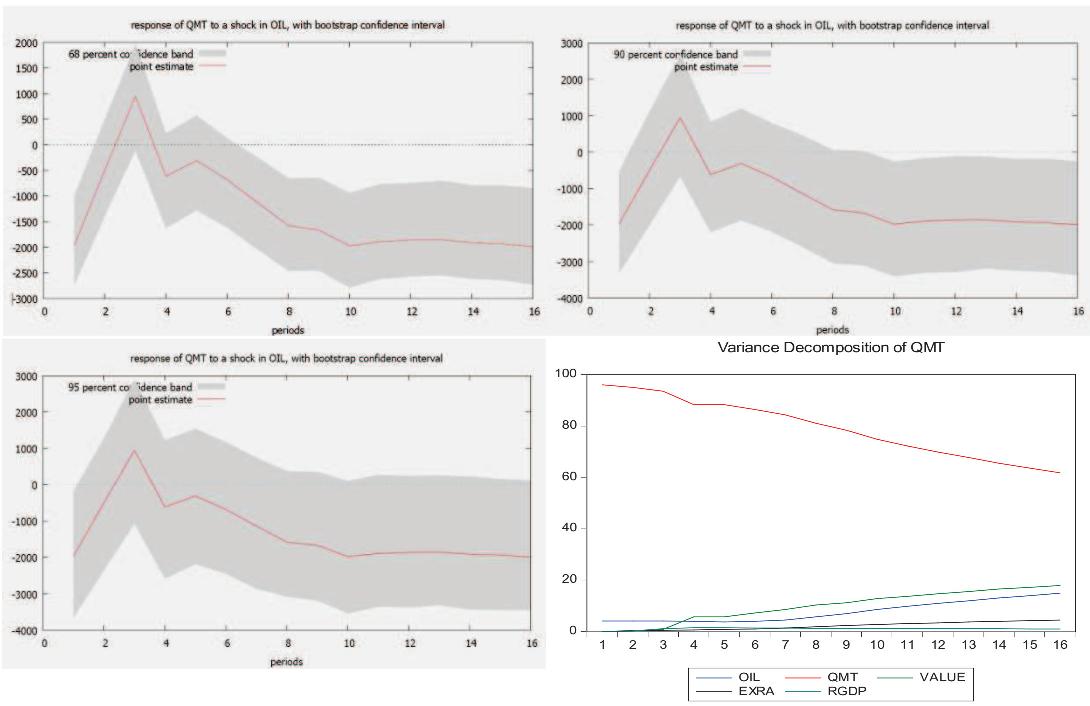

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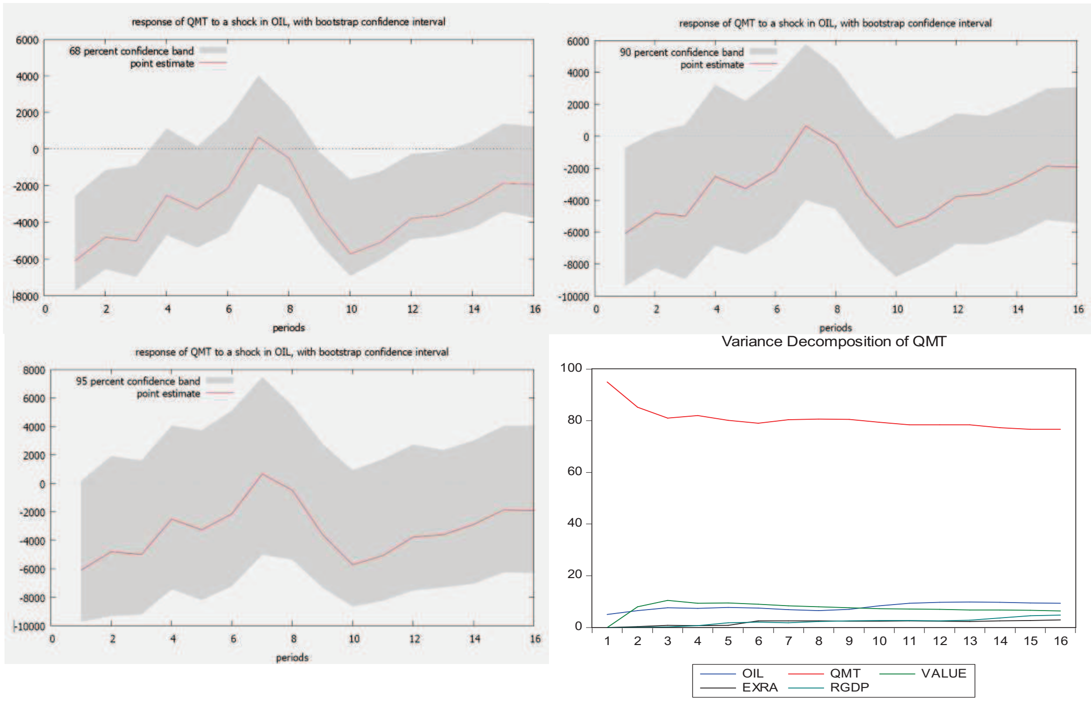
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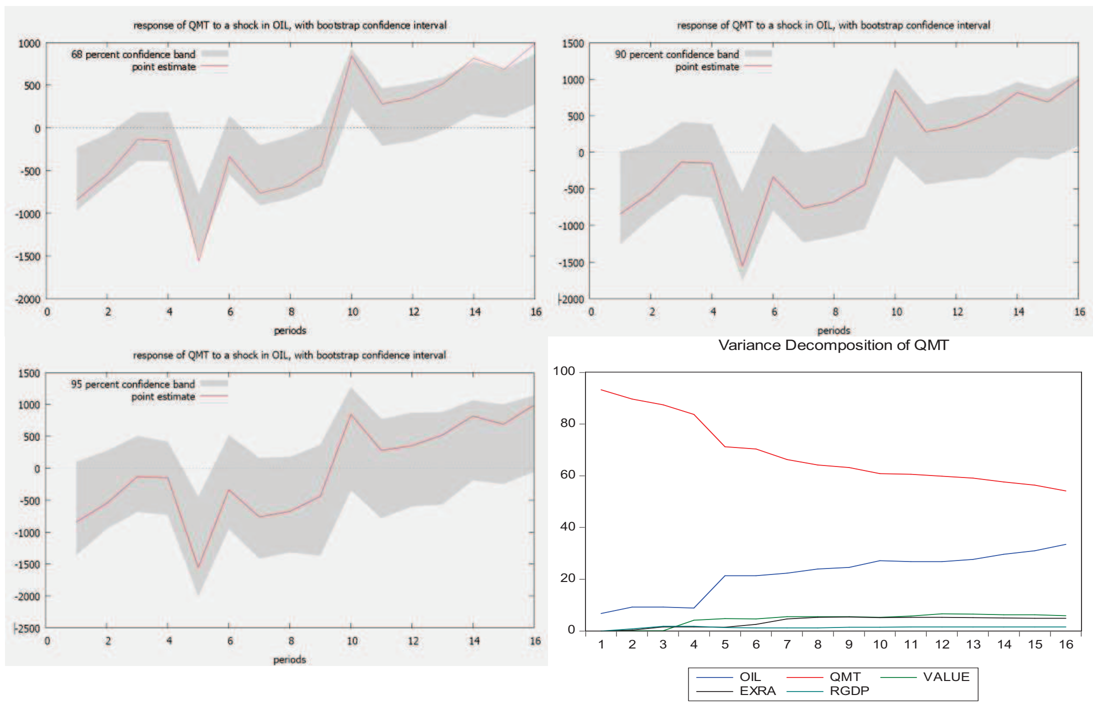
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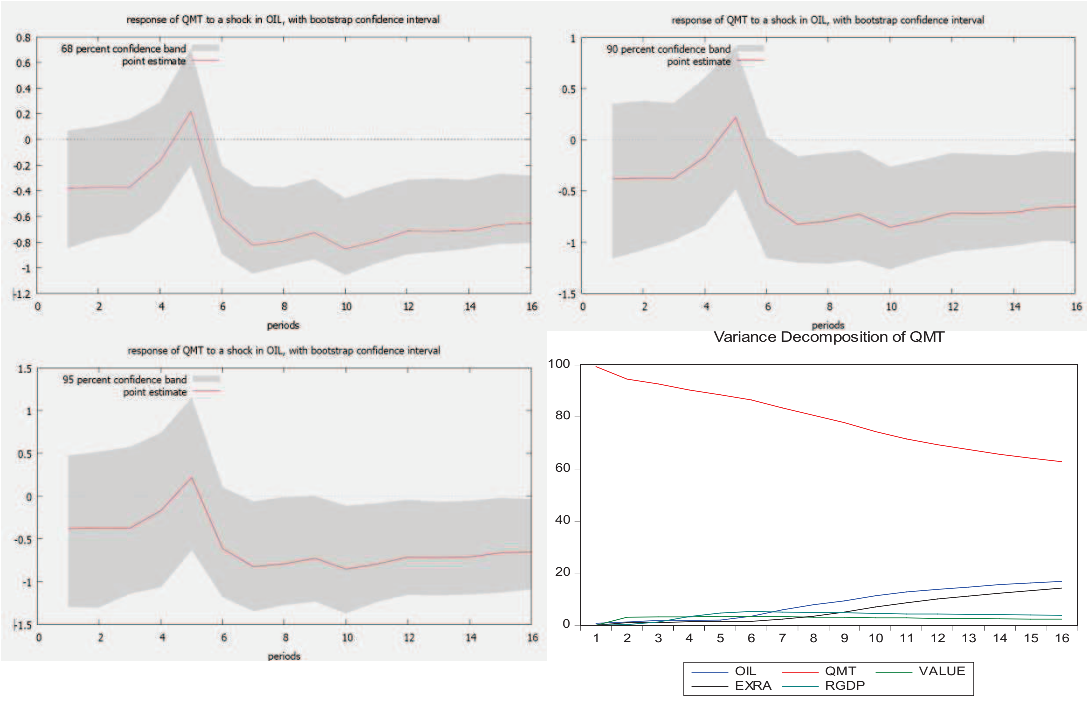
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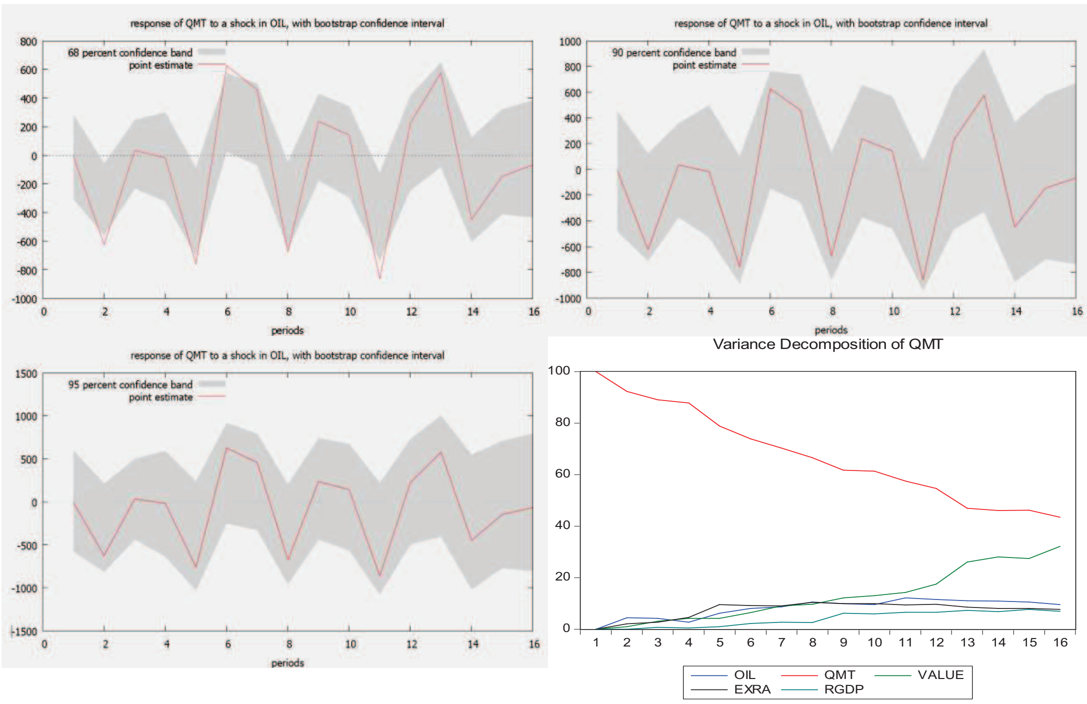
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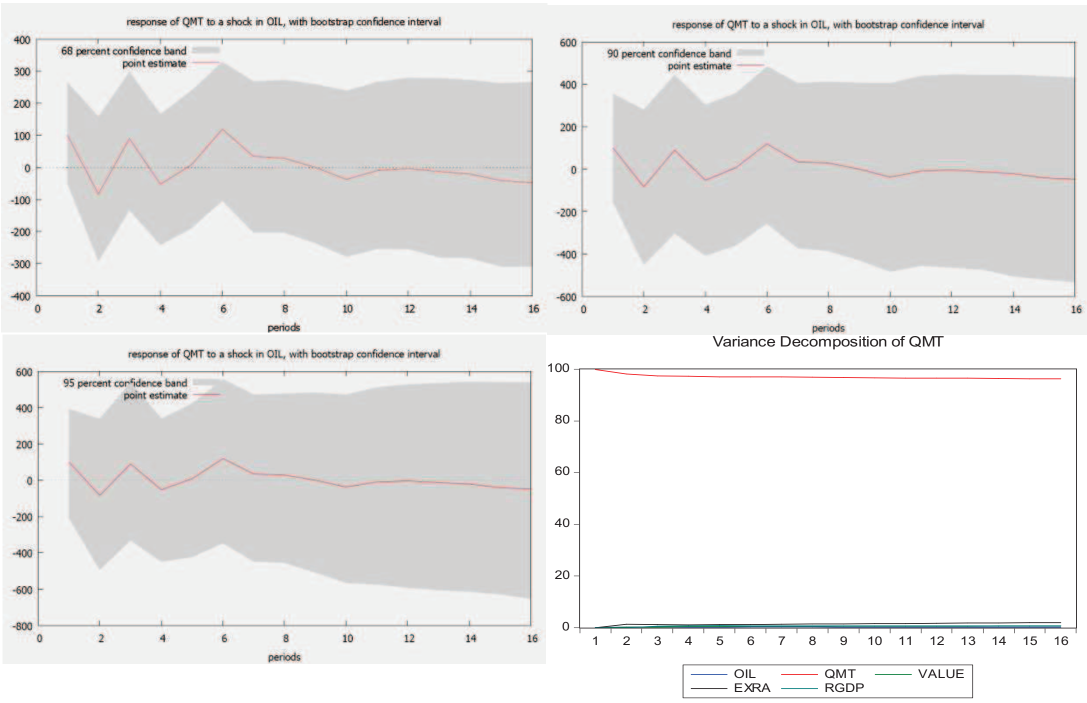
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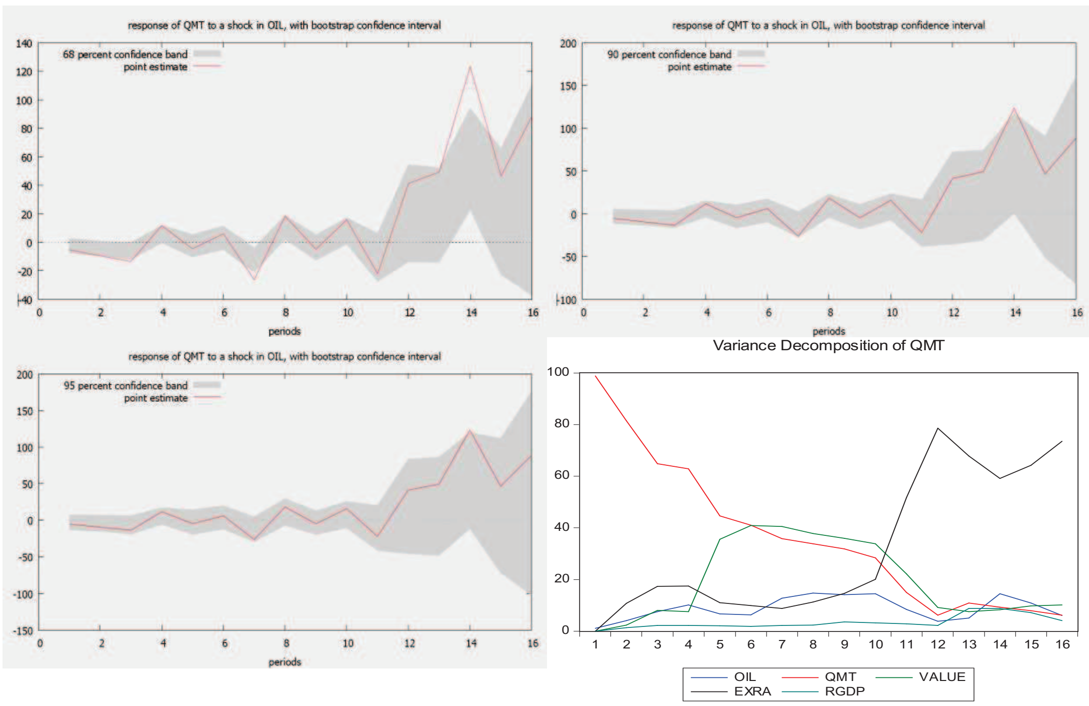
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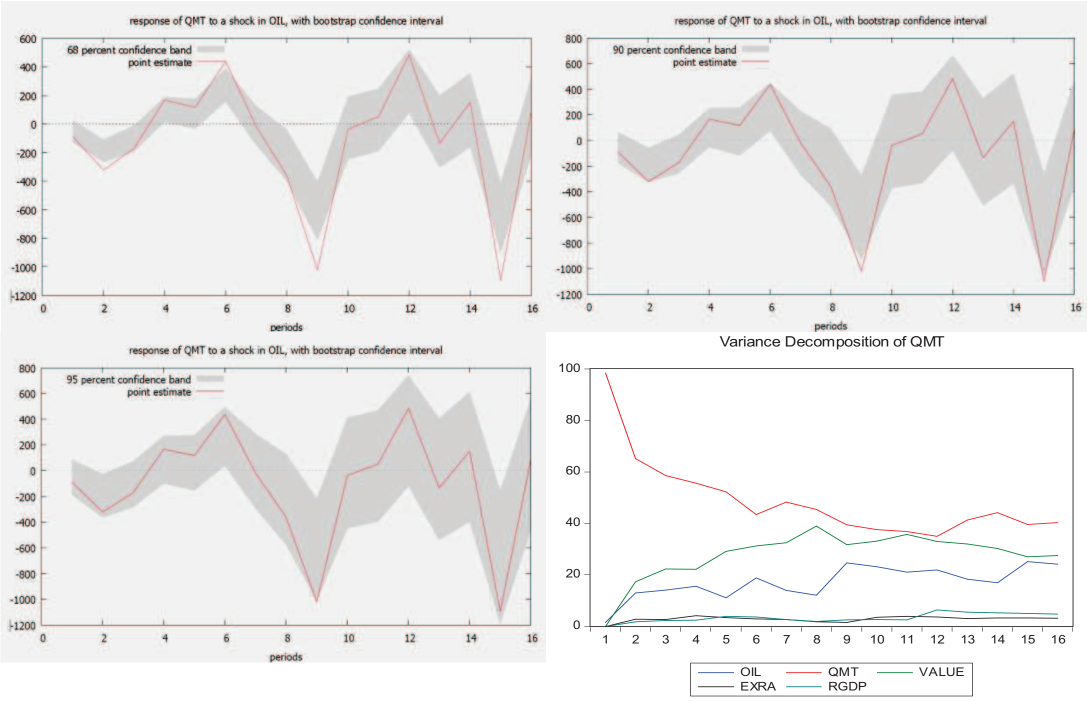
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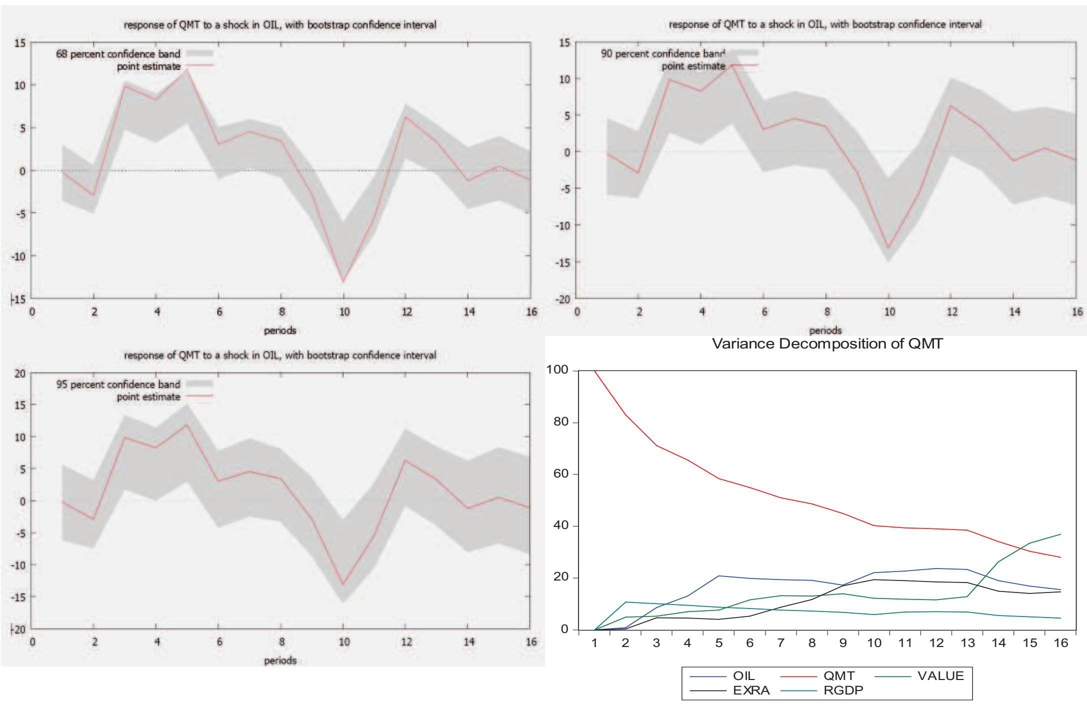
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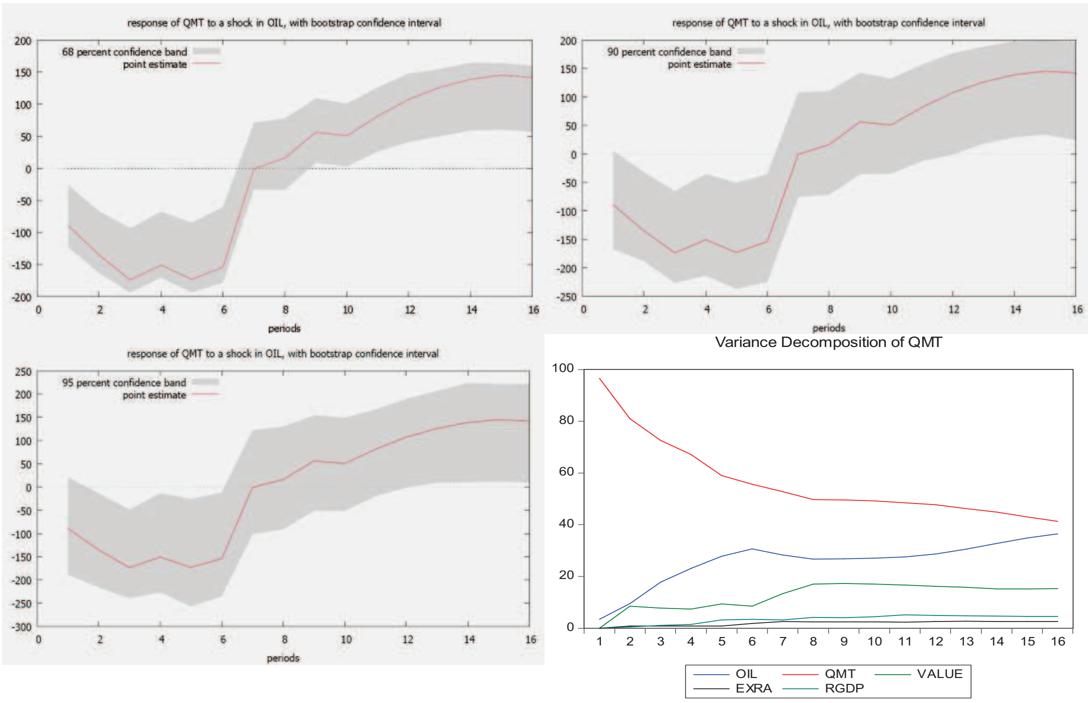
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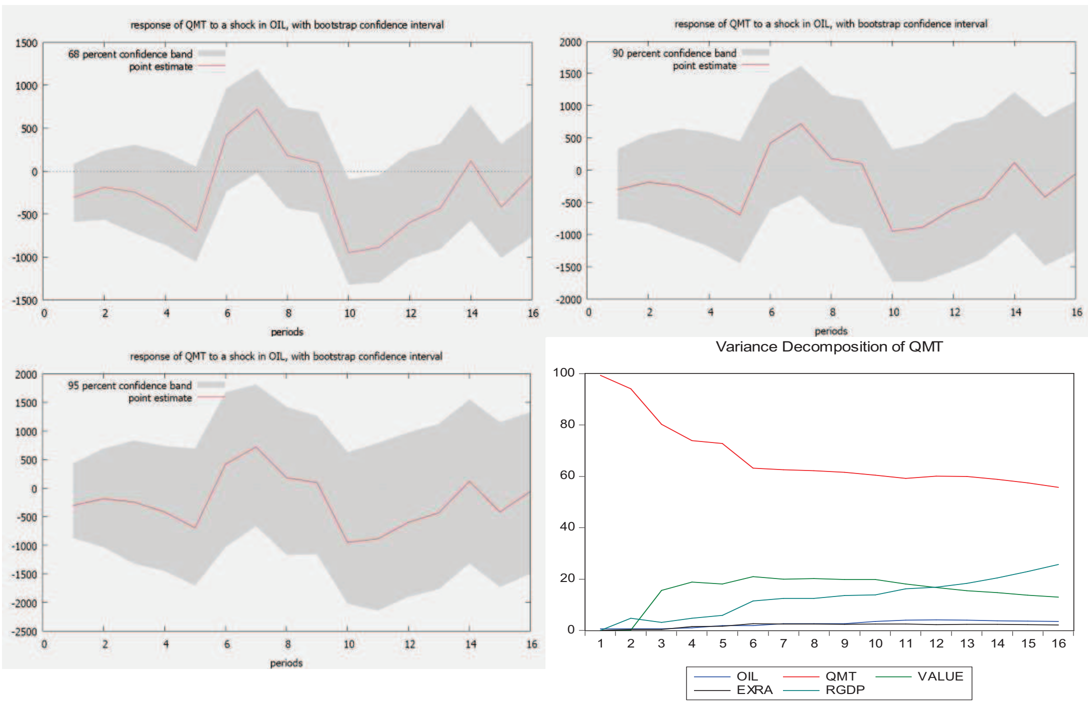
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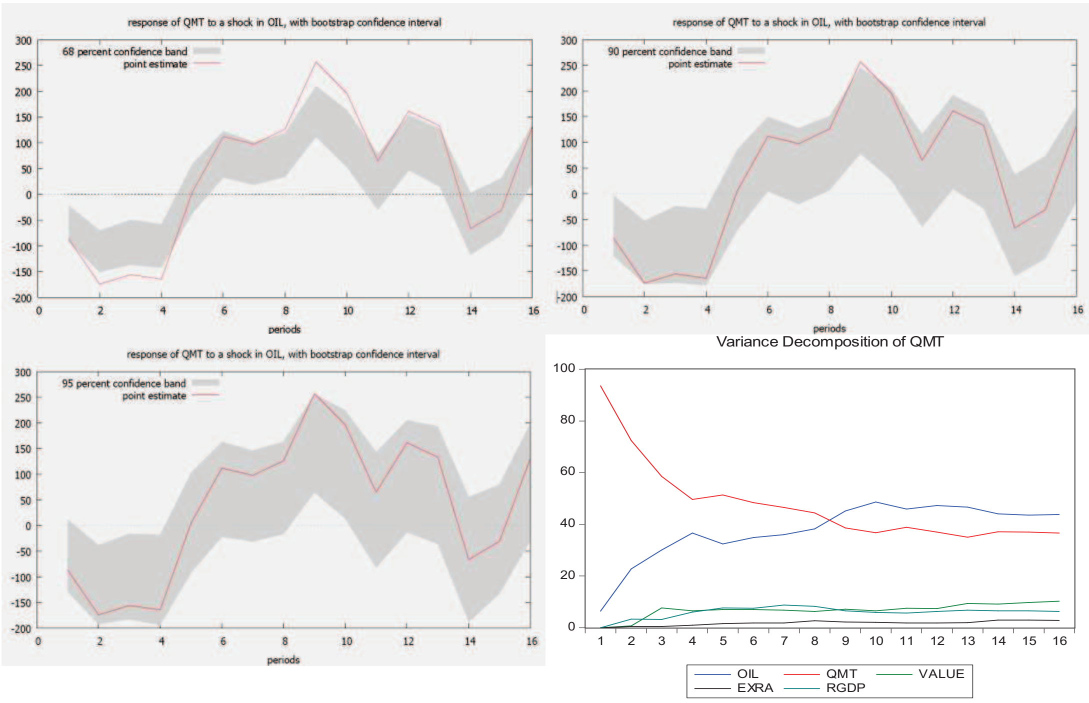
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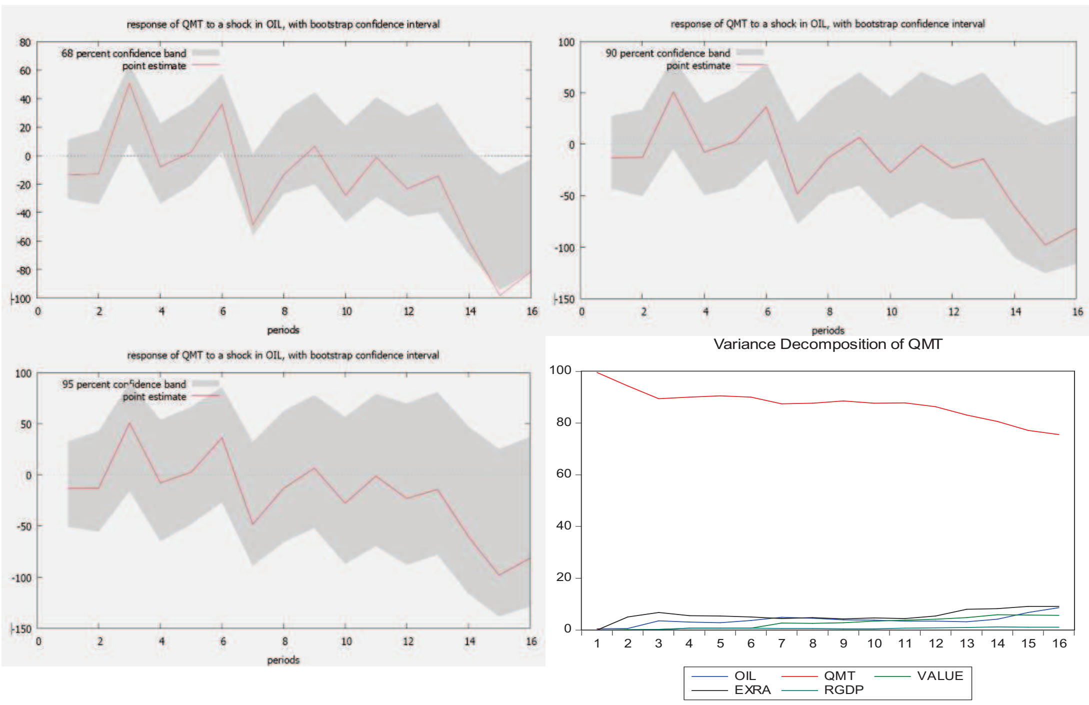
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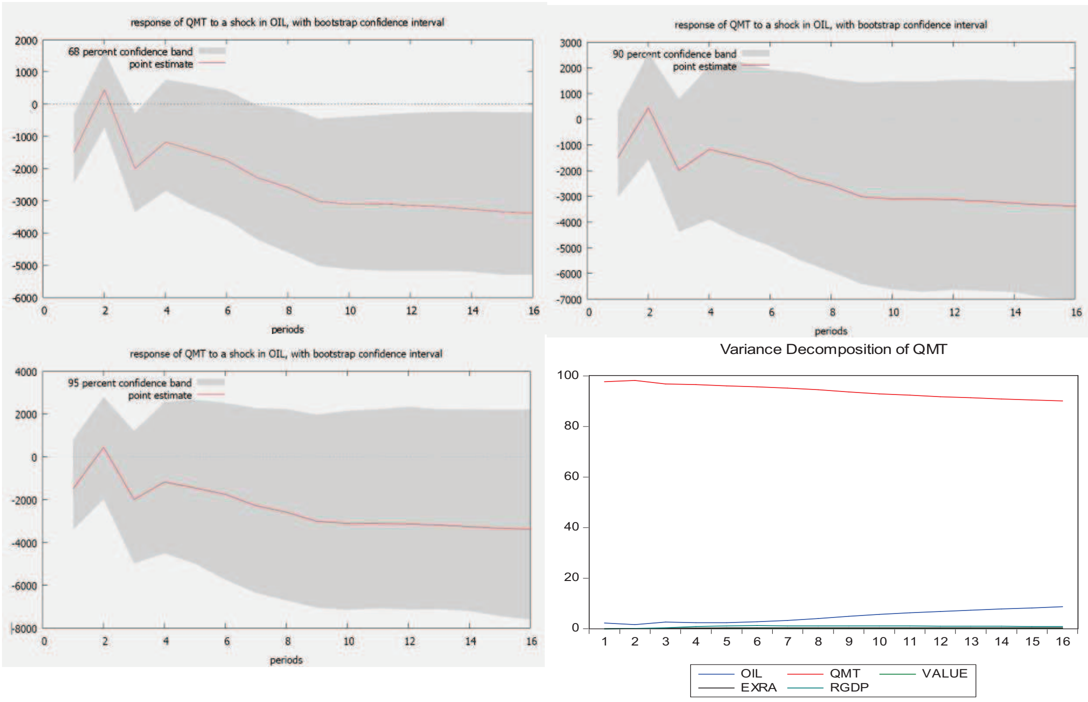
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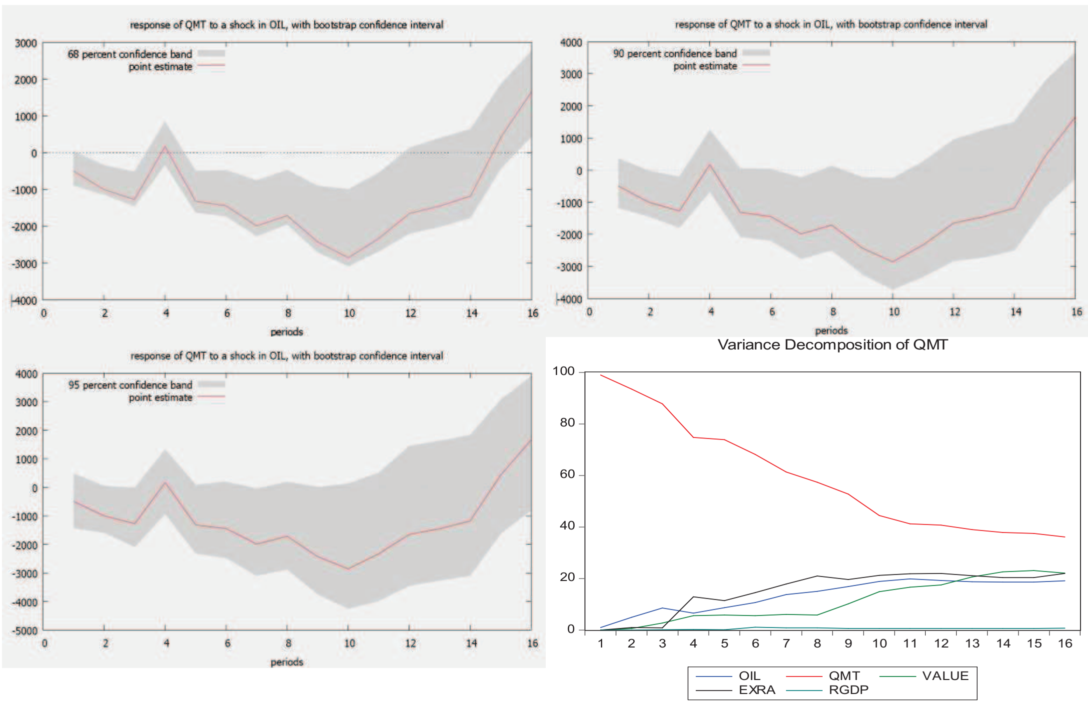
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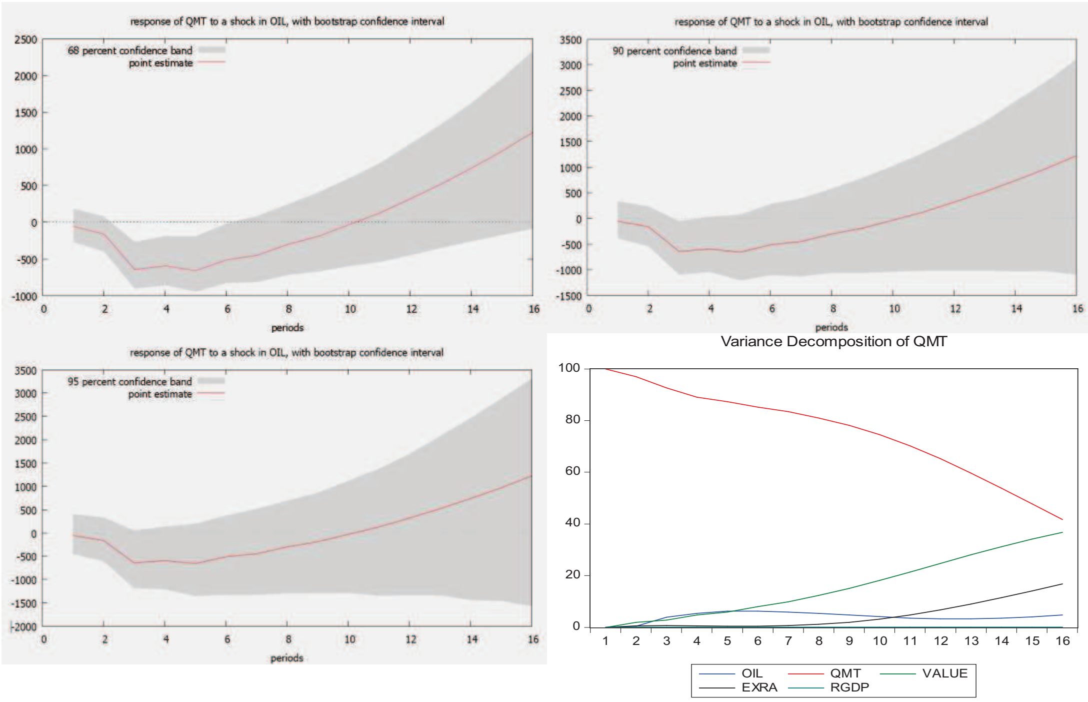
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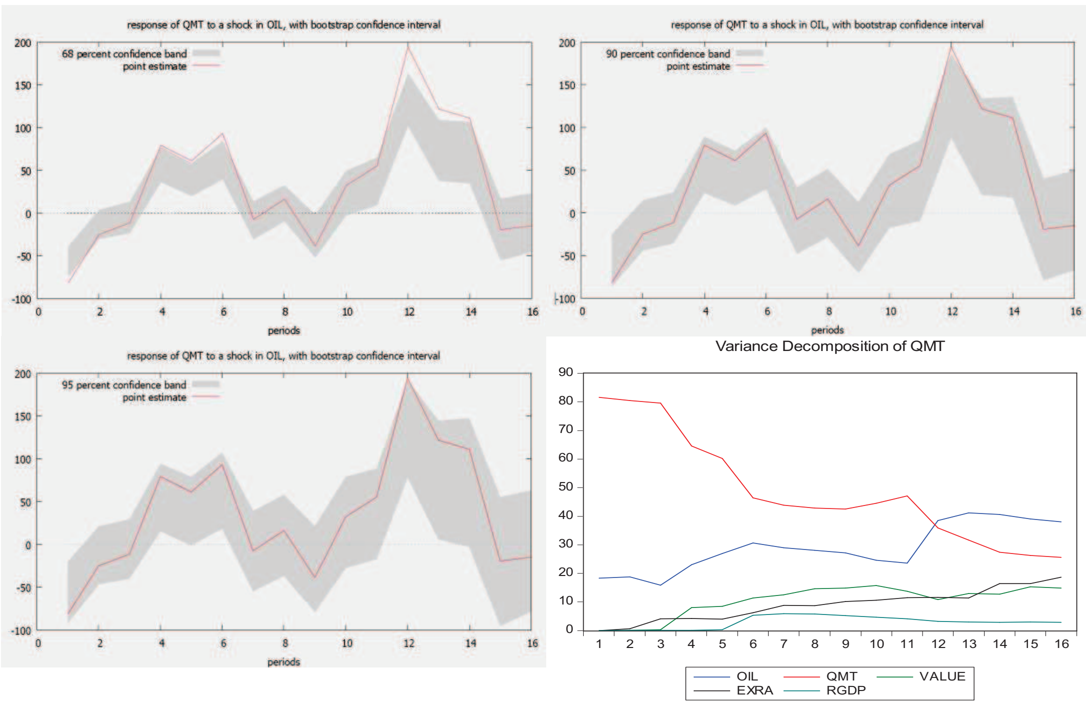
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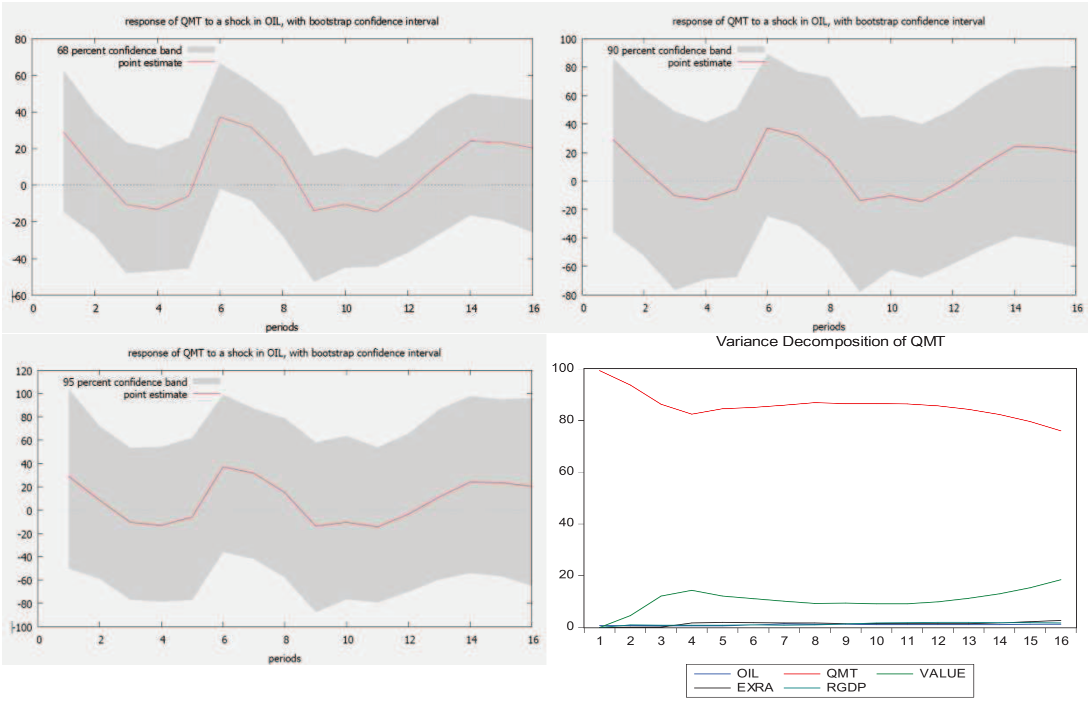
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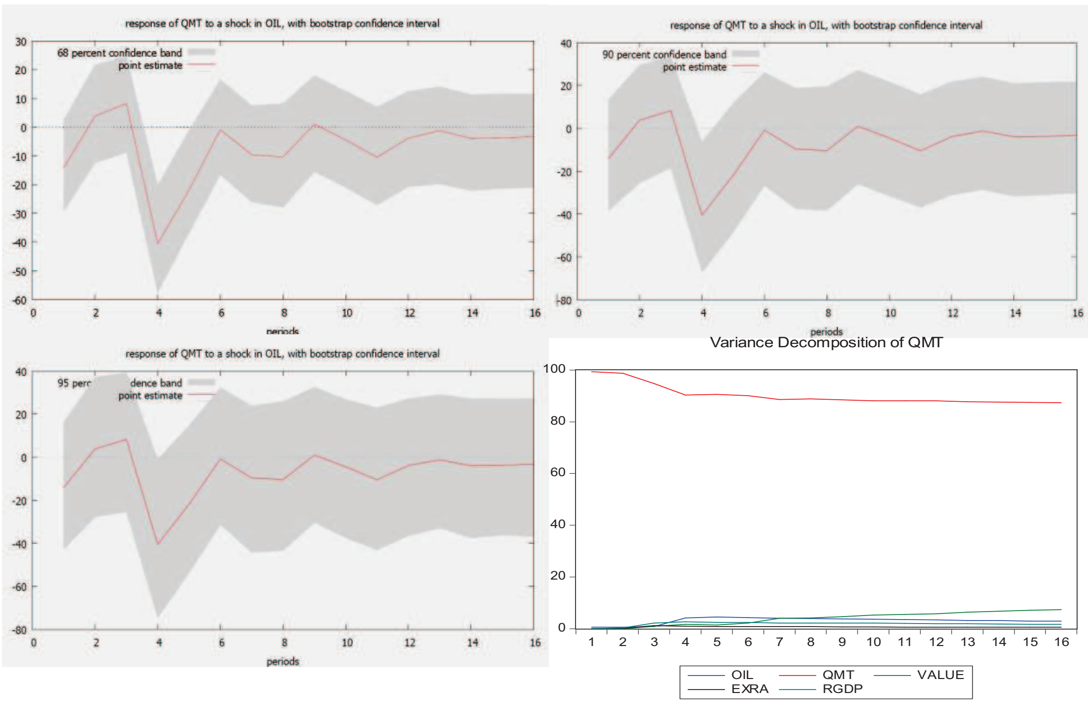
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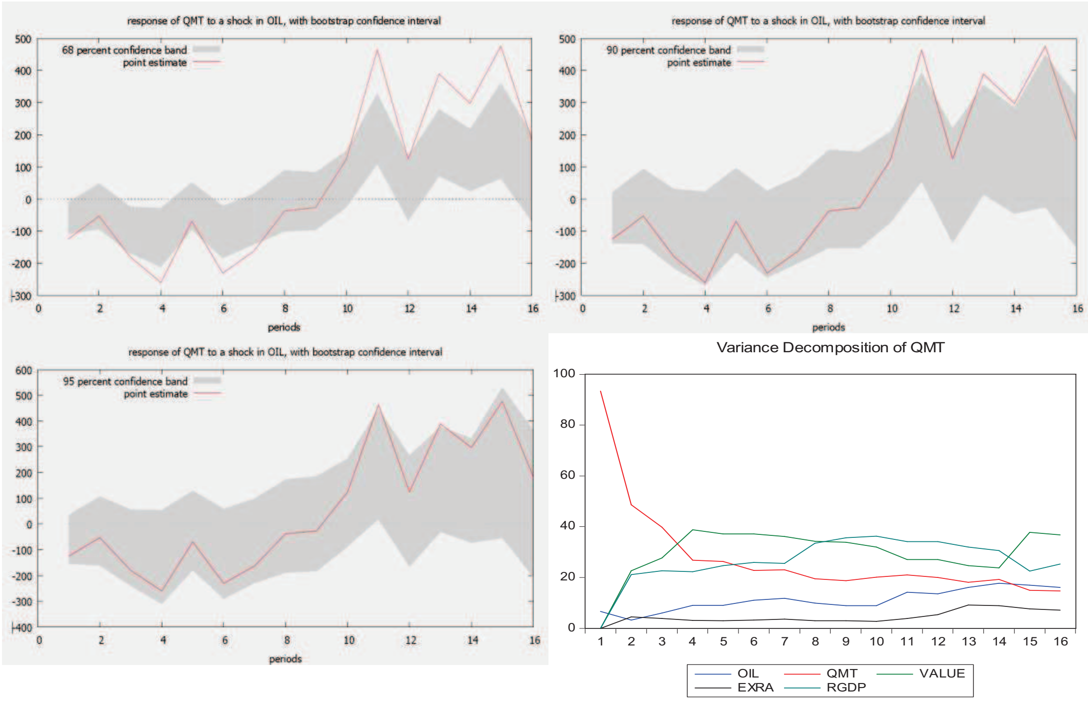
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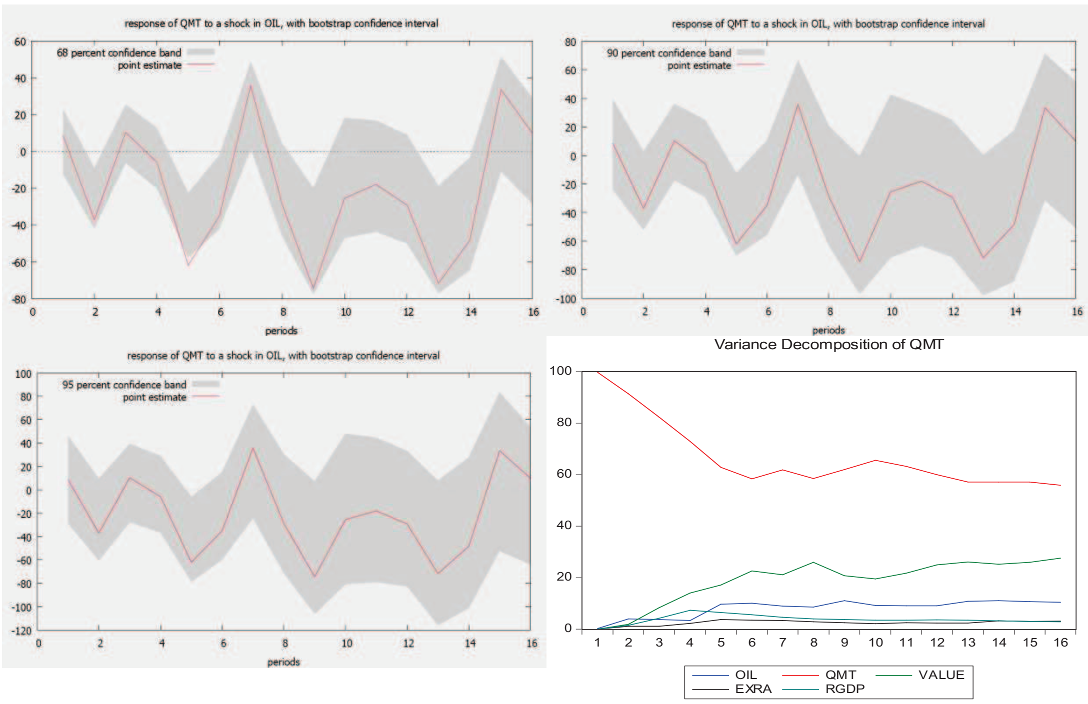
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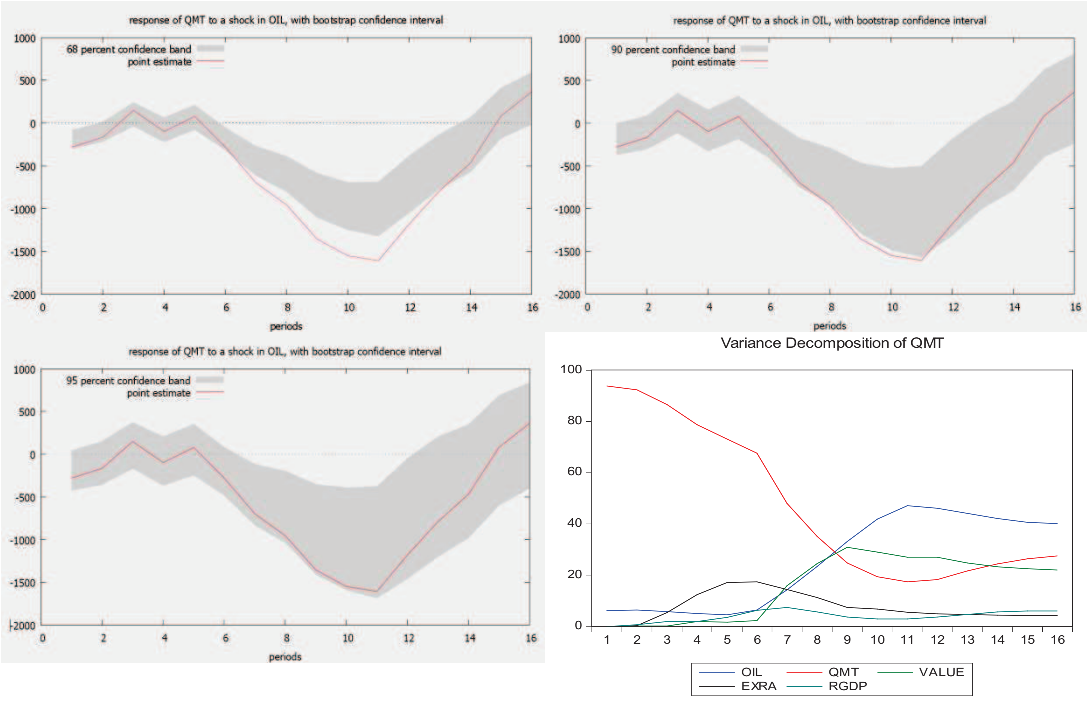
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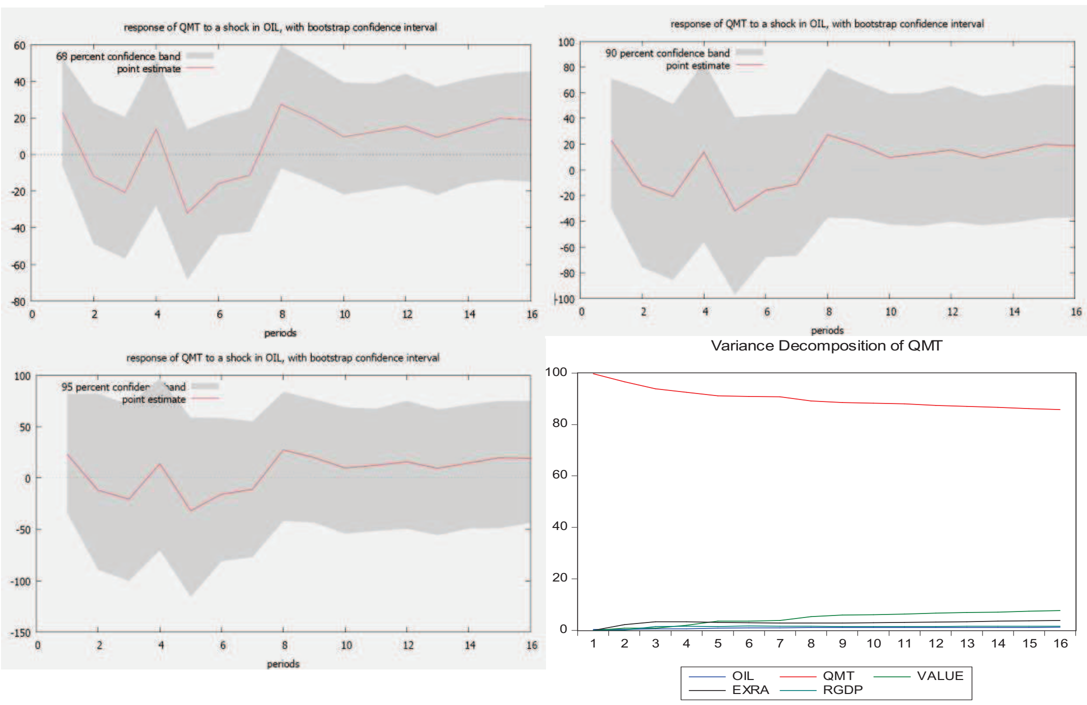
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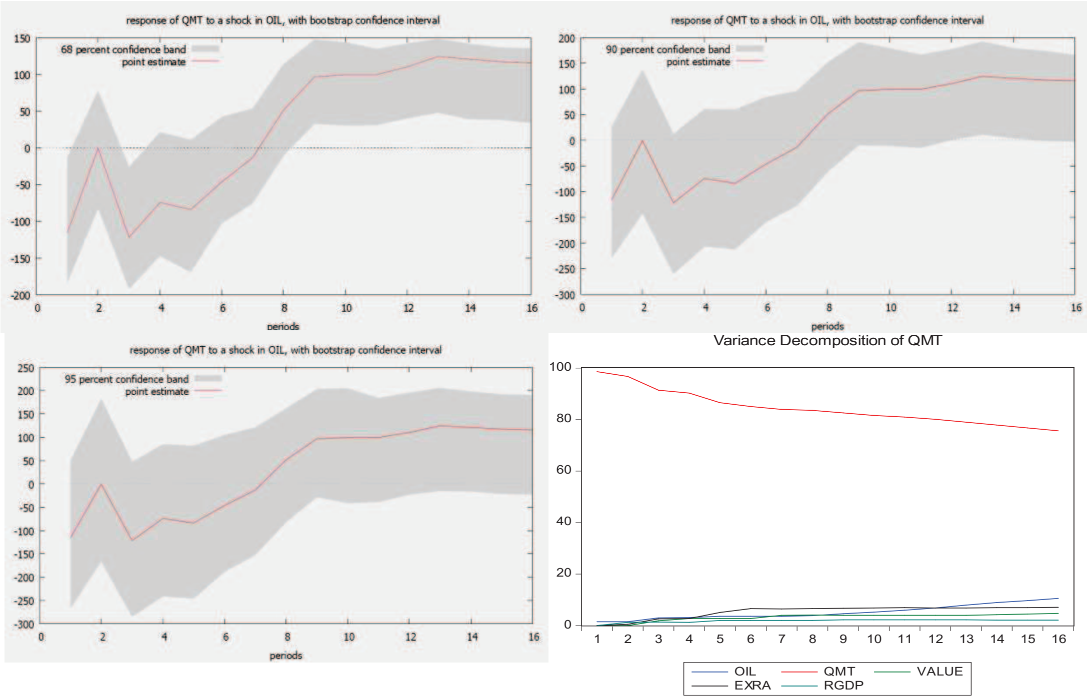
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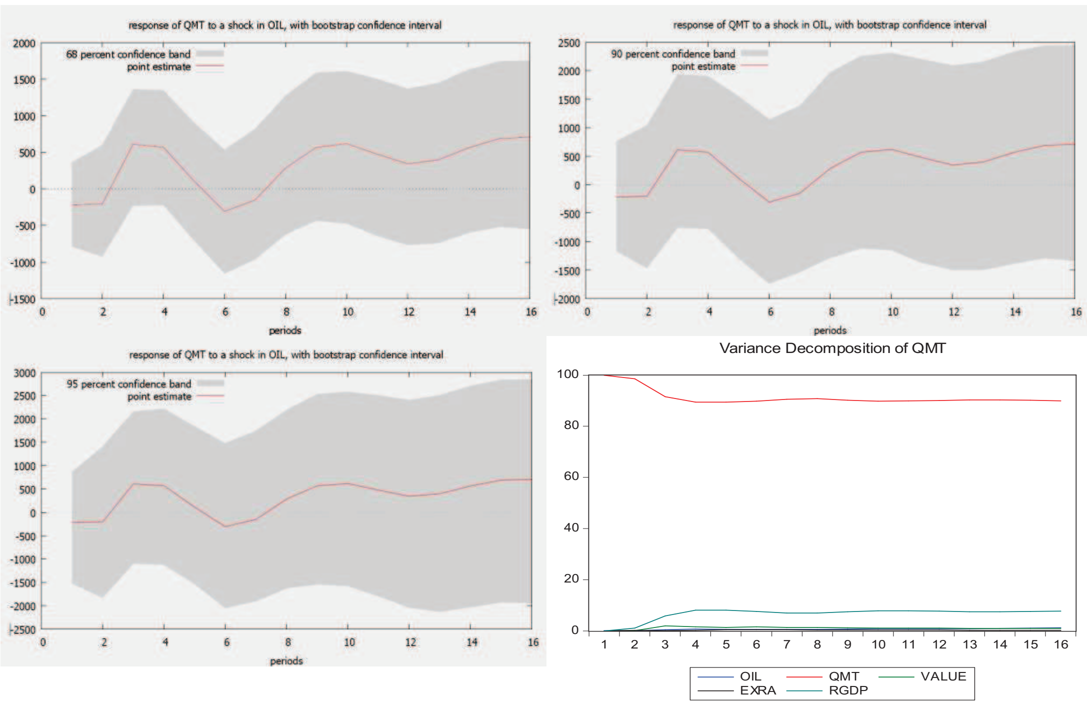
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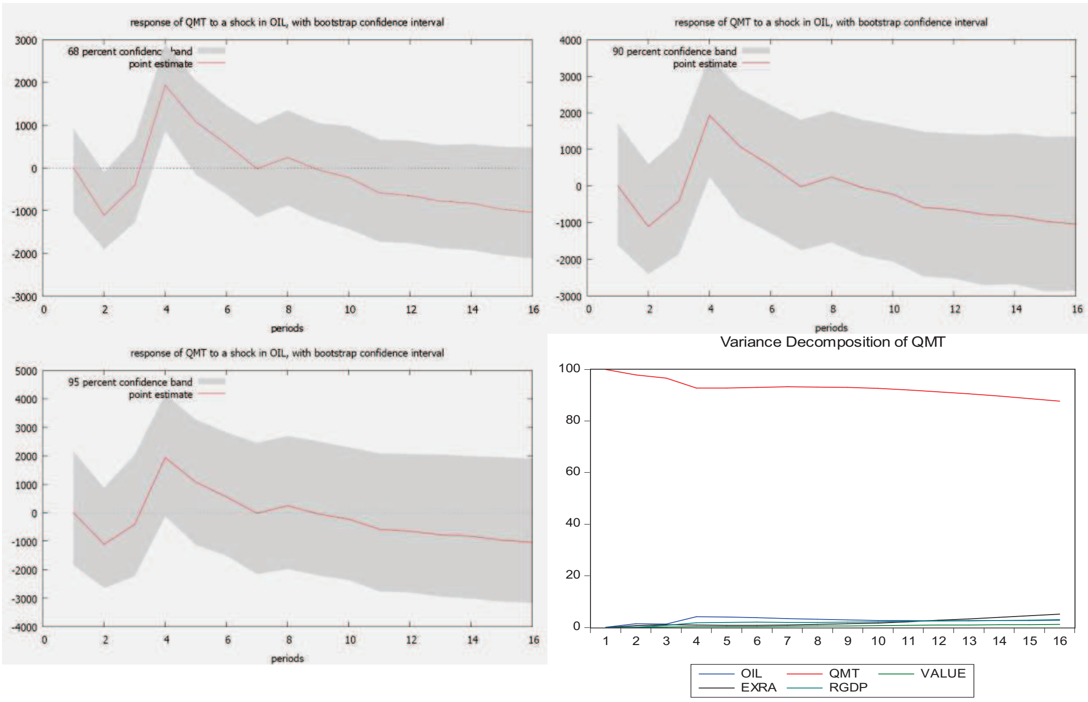
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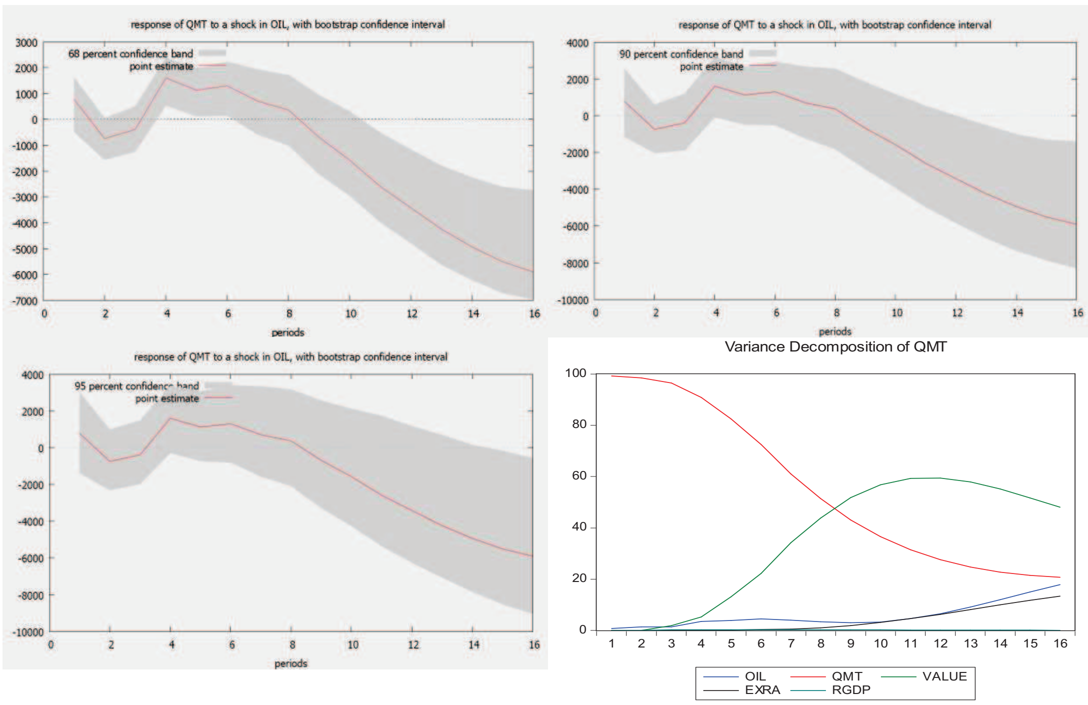
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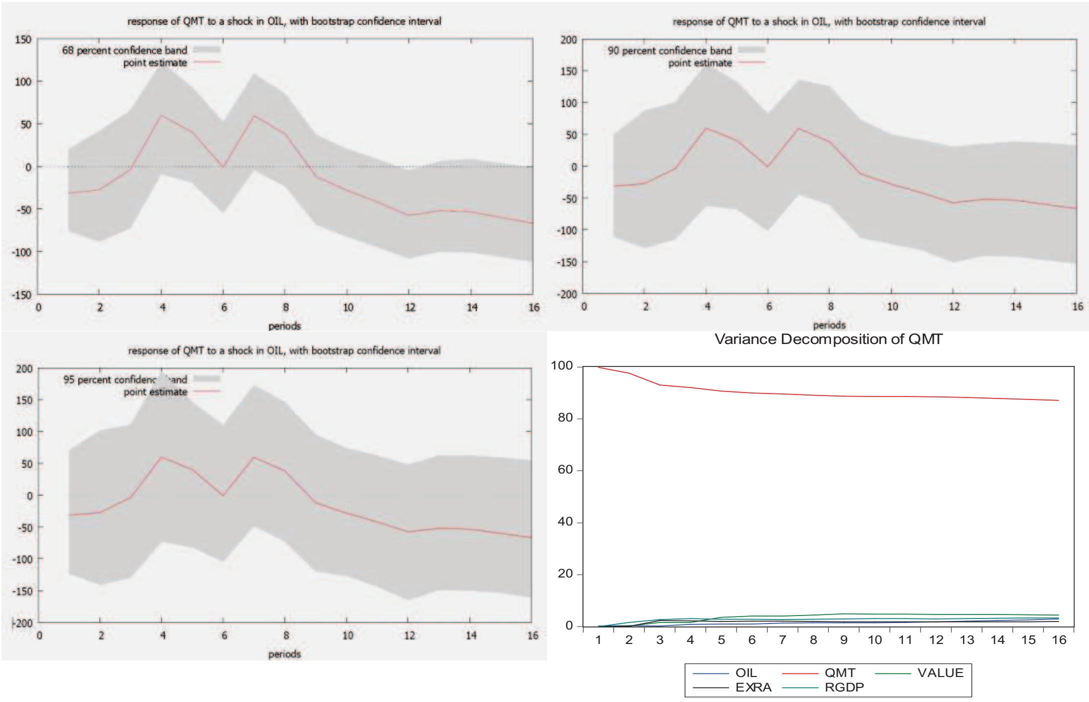
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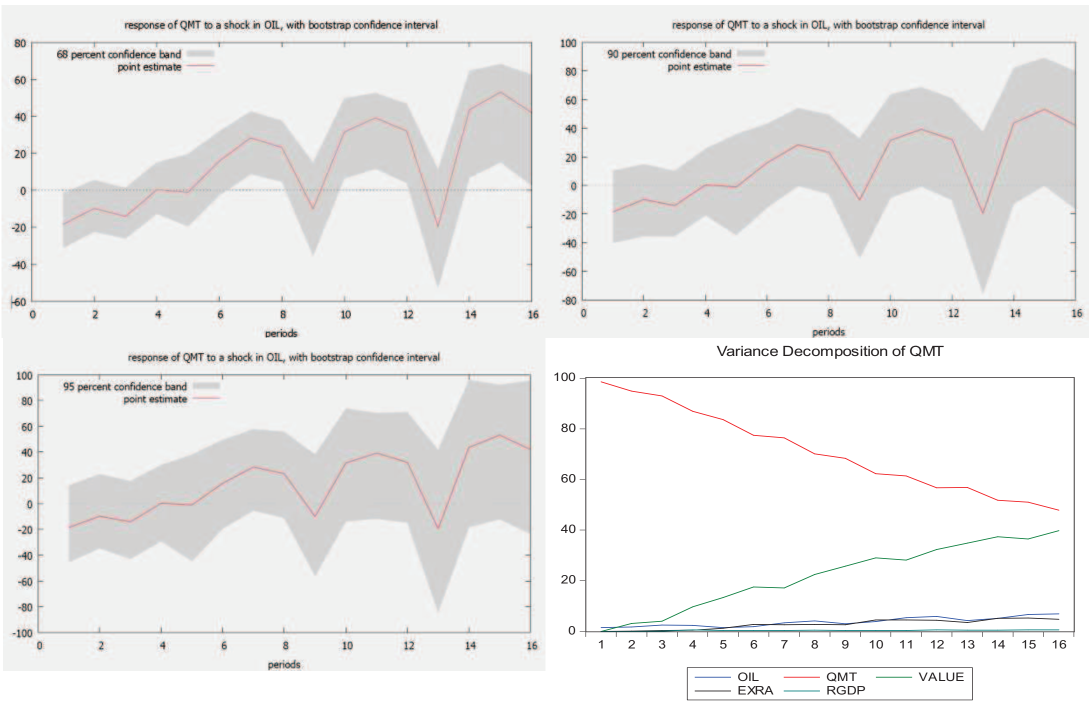
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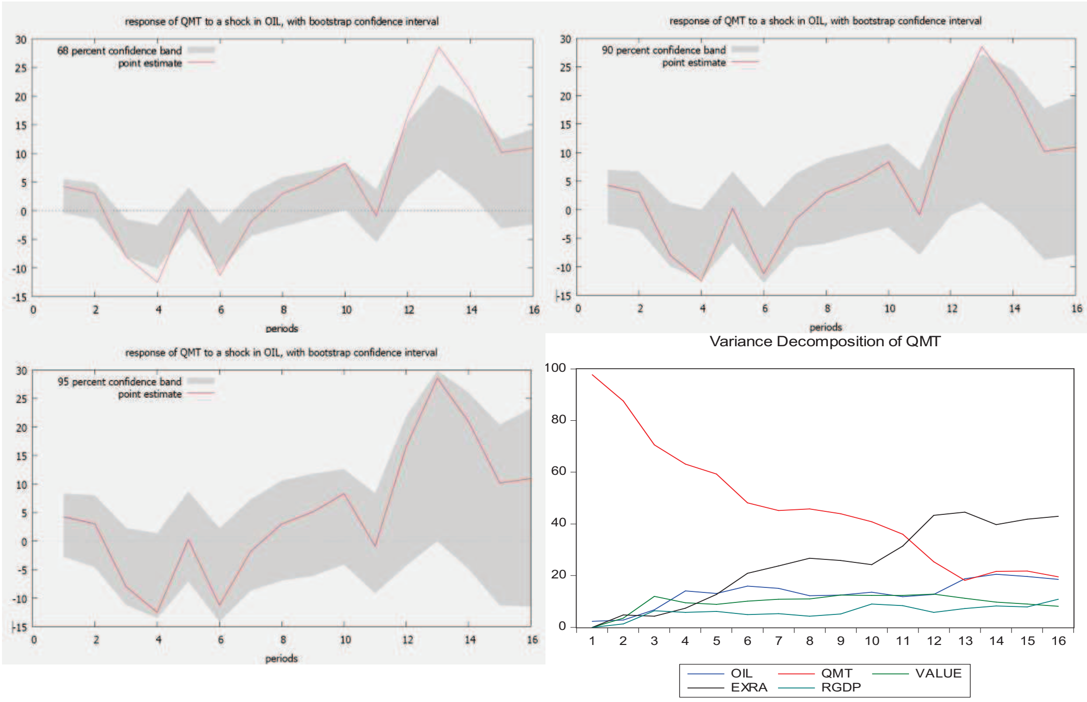
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RGDP

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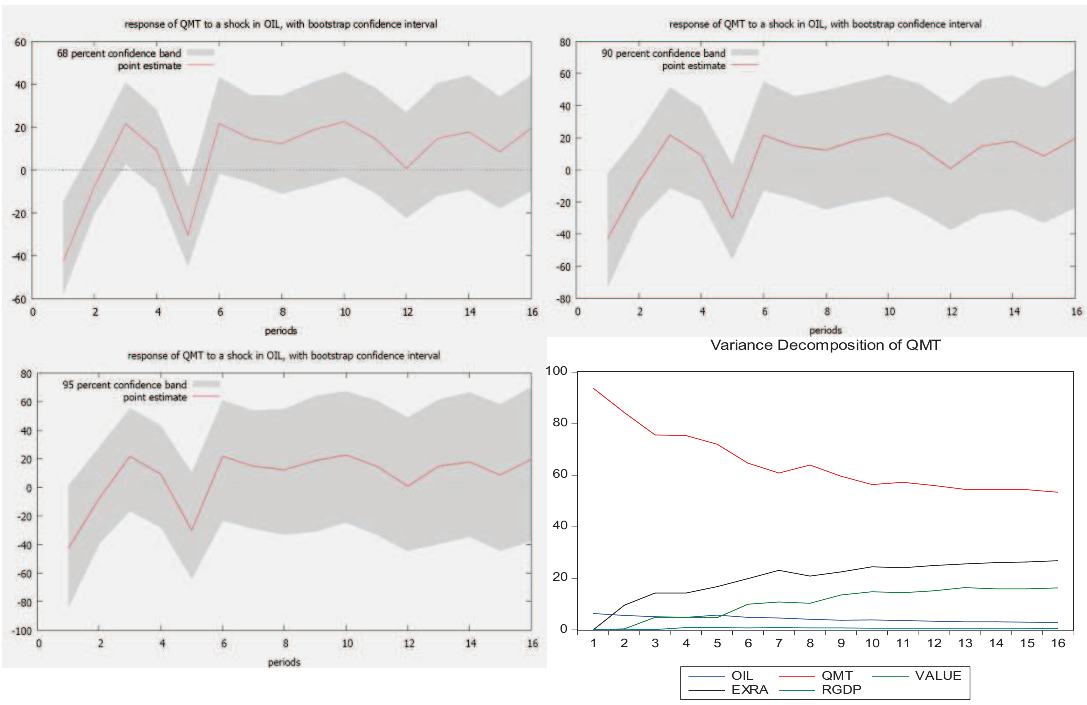
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68 percent confidence band
point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
90 percent confidence band
point estimate
periods
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point estimate
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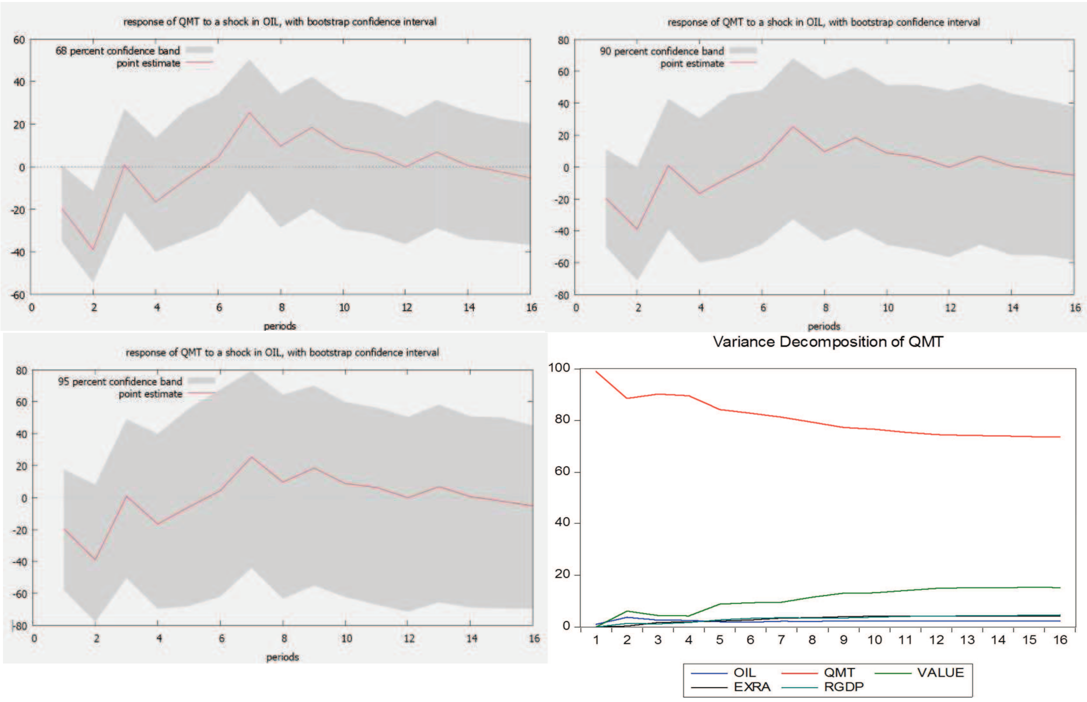
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

4.2.7.2 Japan

1A



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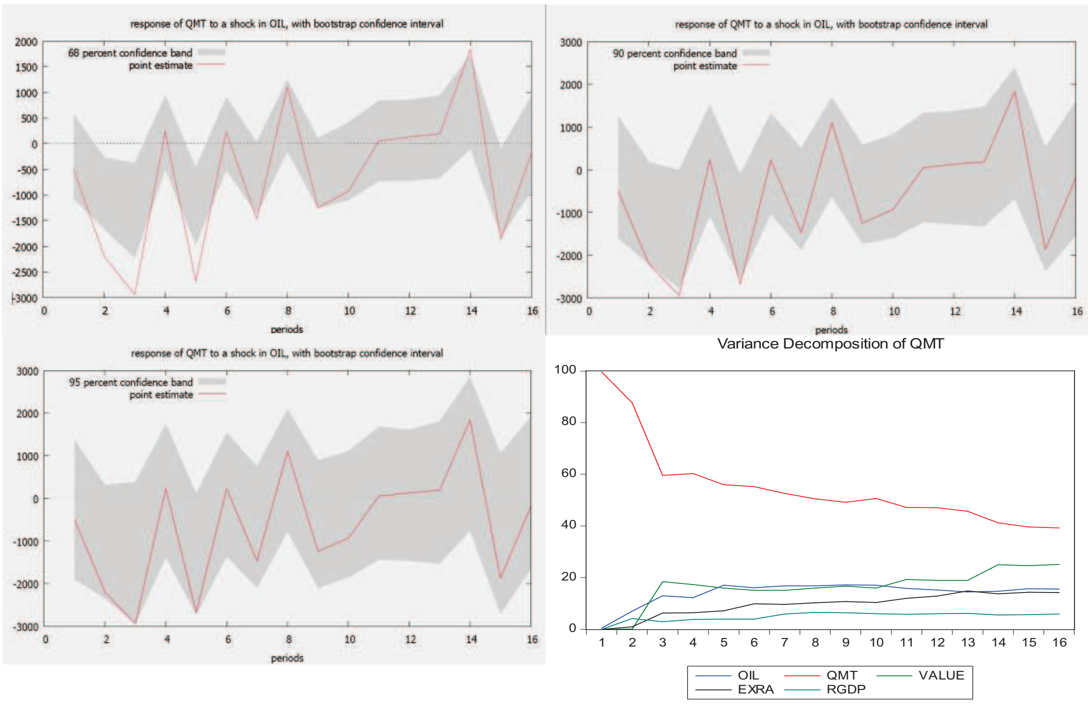

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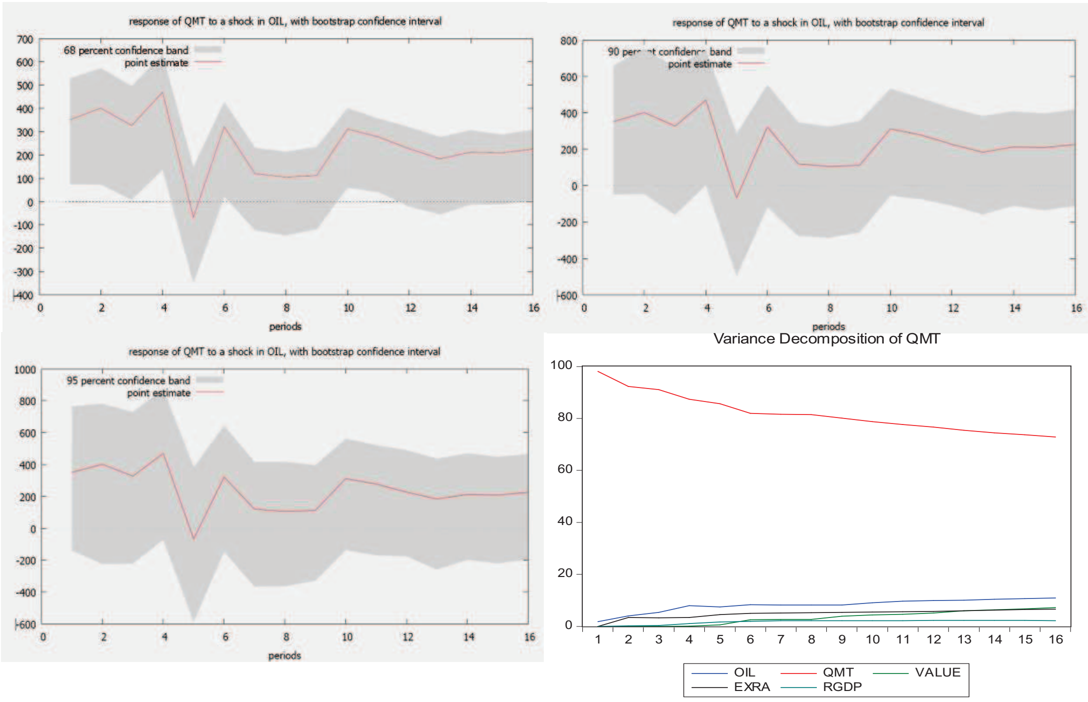
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periods
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point estimate
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point estimate
periods
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OIL
QMT
VALUE
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RGDP

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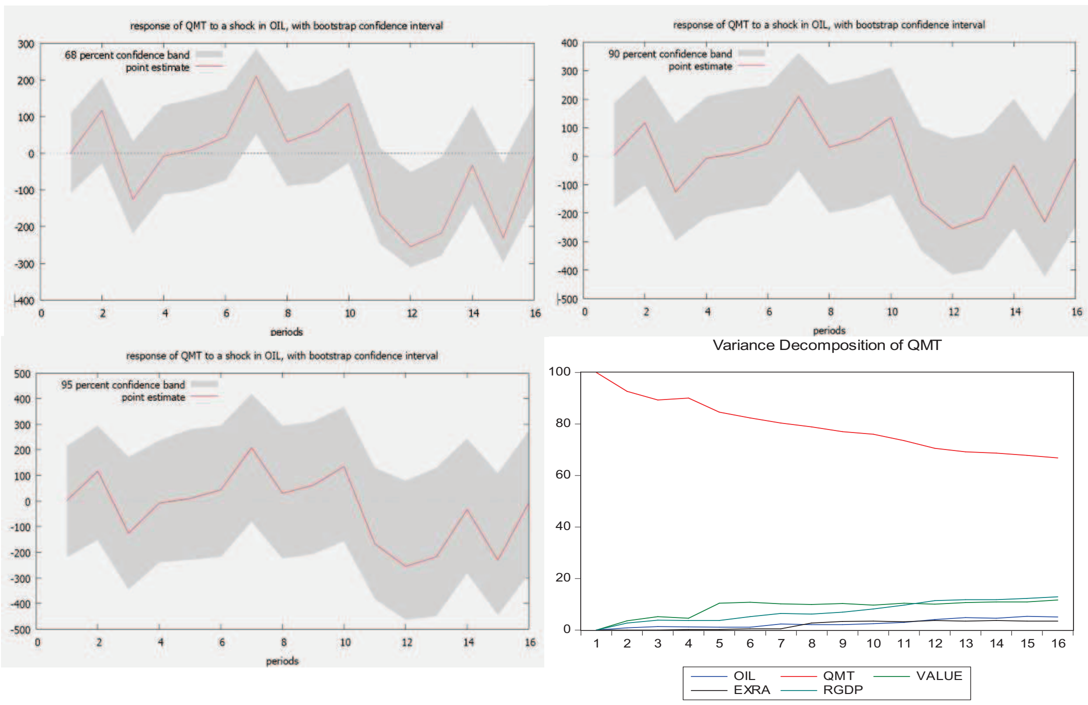
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periods
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point estimate
periods
Variance Decomposition of QMT
OIL
QMT
VALUE
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RGDP

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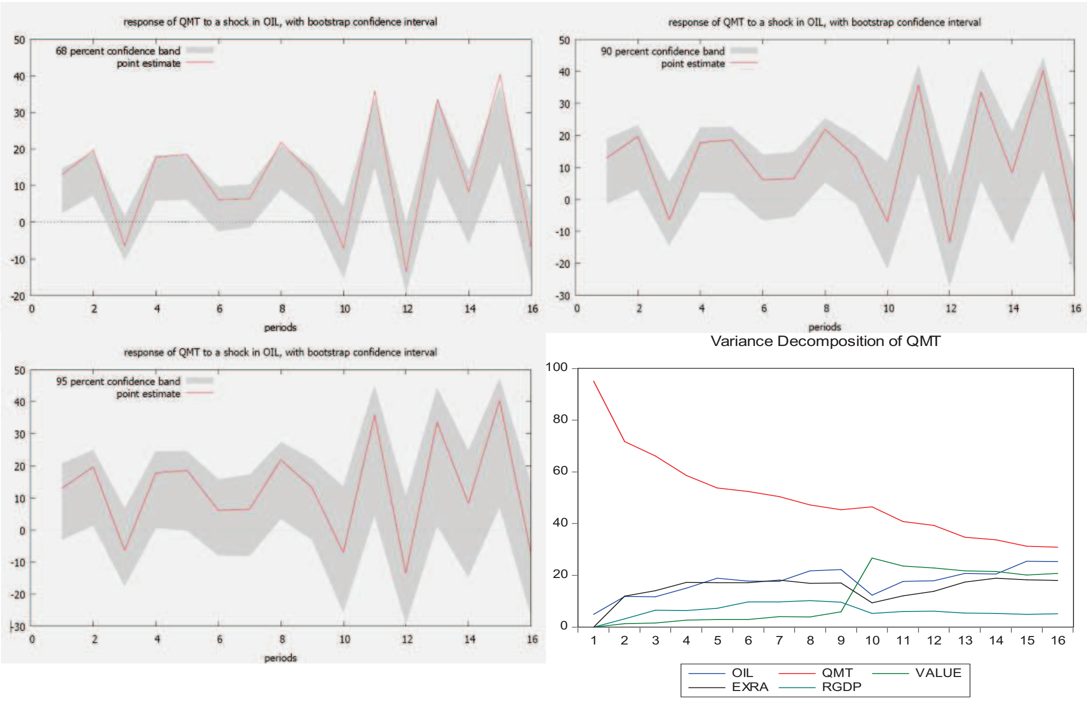
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OIL
QMT
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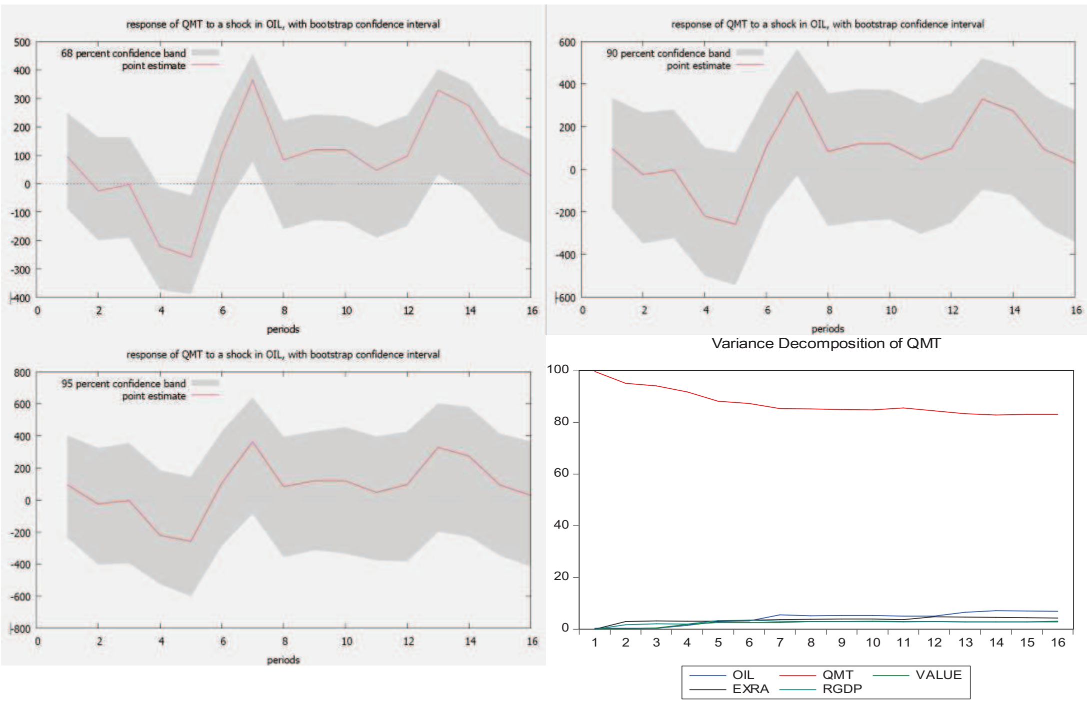
RGDP

6A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periods
Variance Decomposition of QMT
OIL
QMT
VALUE
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RGDP

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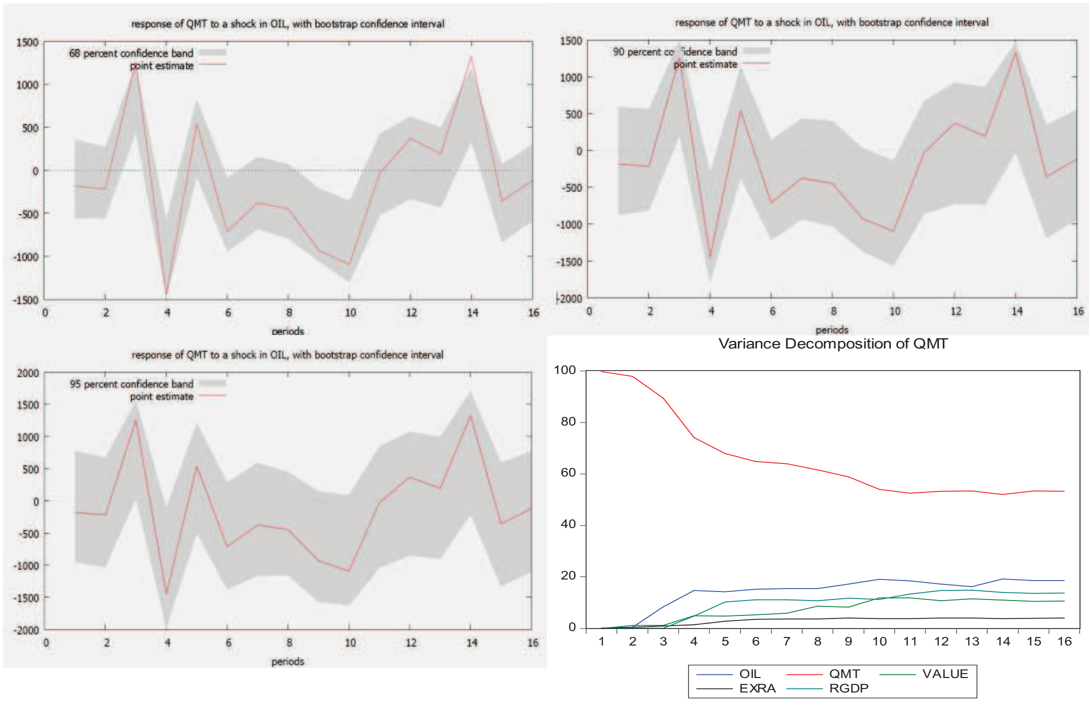
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Variance Decomposition of QMT
OIL
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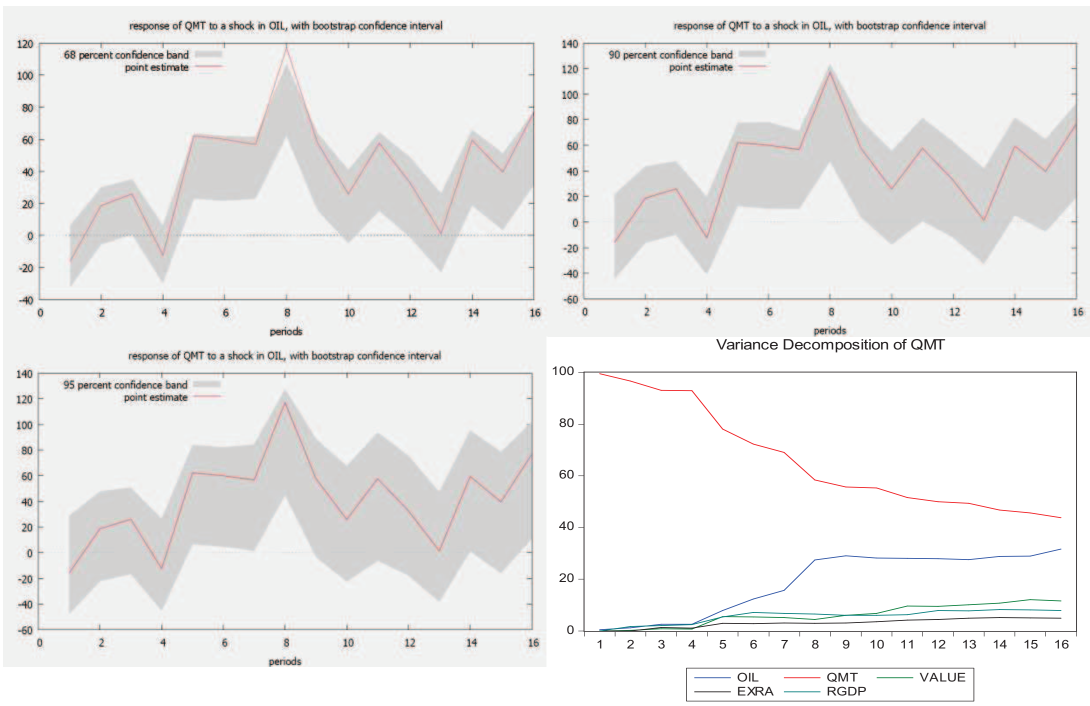
RGDP

8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OIL
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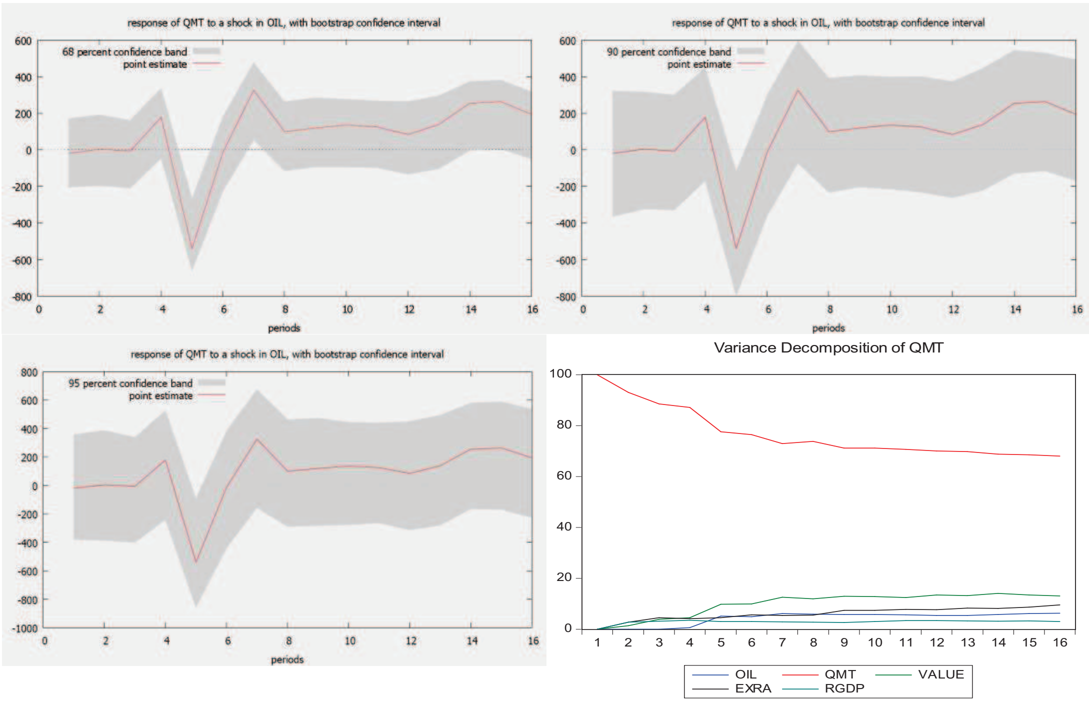
RGDP

14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point estimate
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OIL
QMT
VALUE
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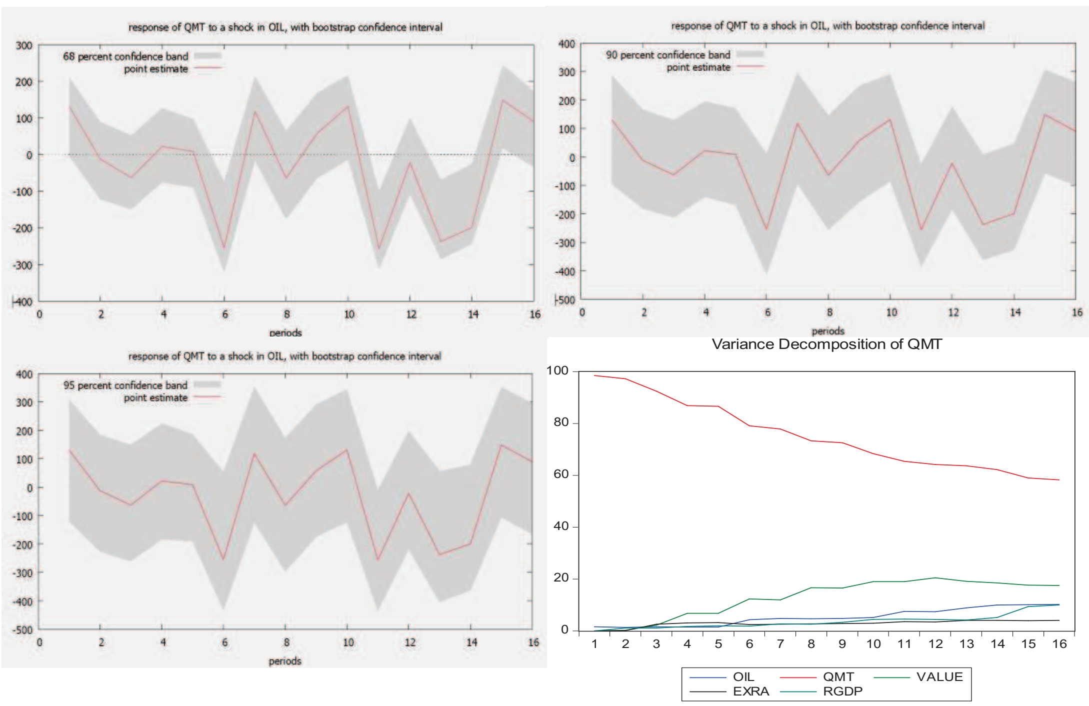
RGDP

14A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Variance Decomposition of QMT
OIL
QMT
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RGDP

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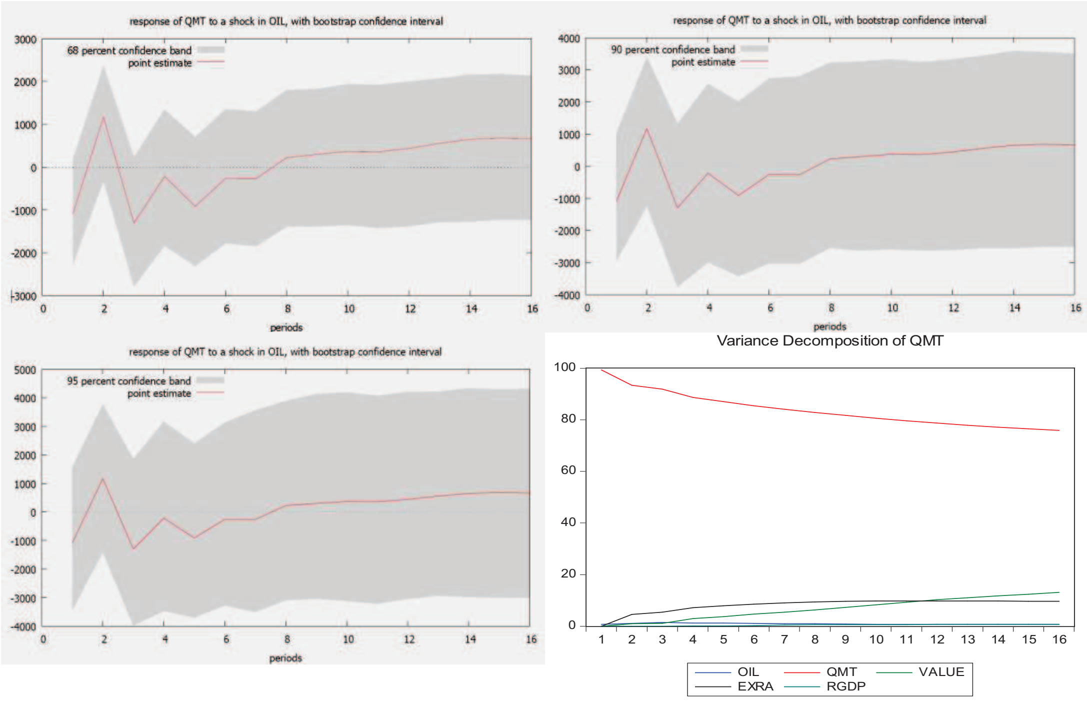
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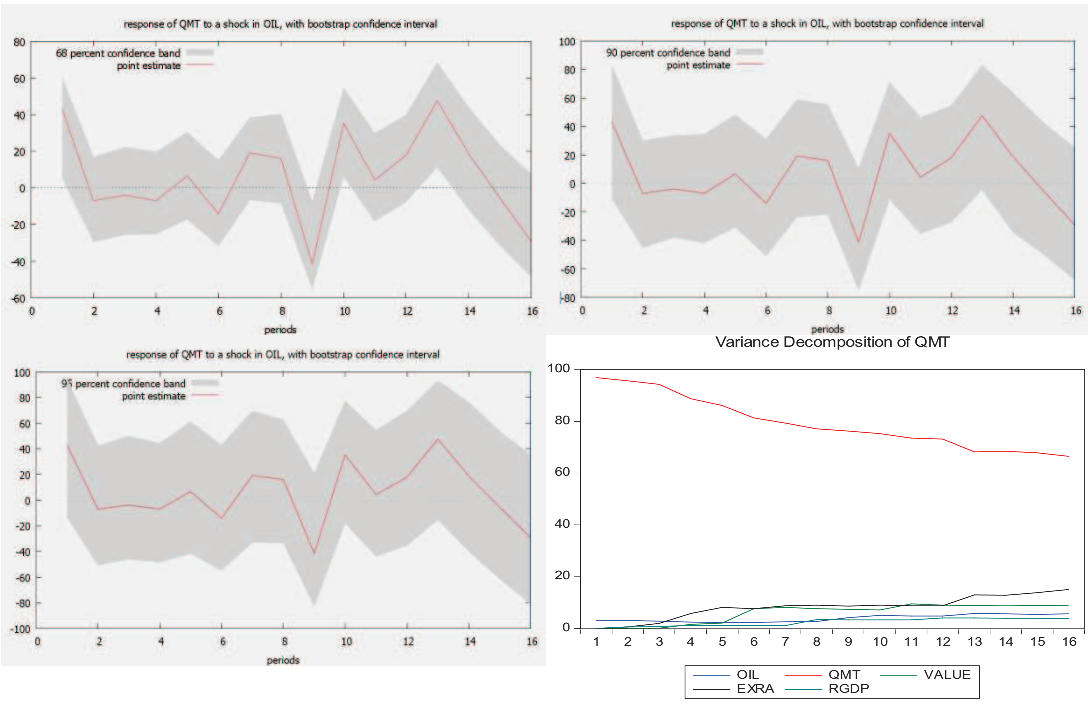
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

16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95 percent confidence band
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Variance Decomposition of QMT
OIL
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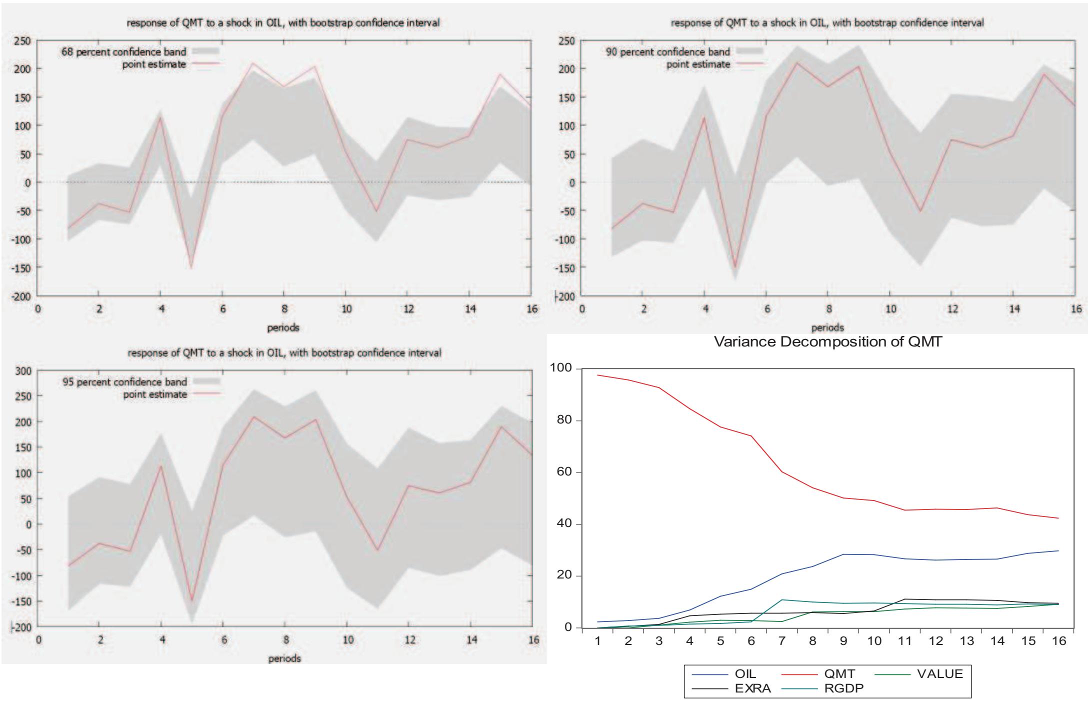
EXRA
RGDP

17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OIL
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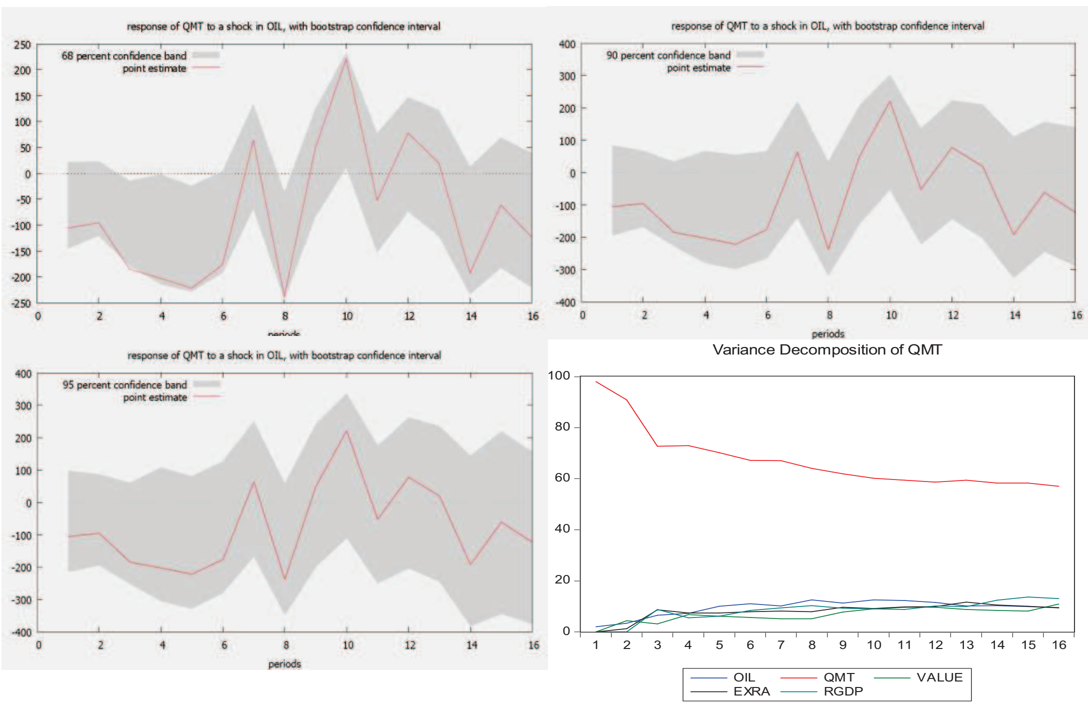
RGDP

18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90 percent confidence band
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Variance Decomposition of QMT
OIL
QMT
VALUE
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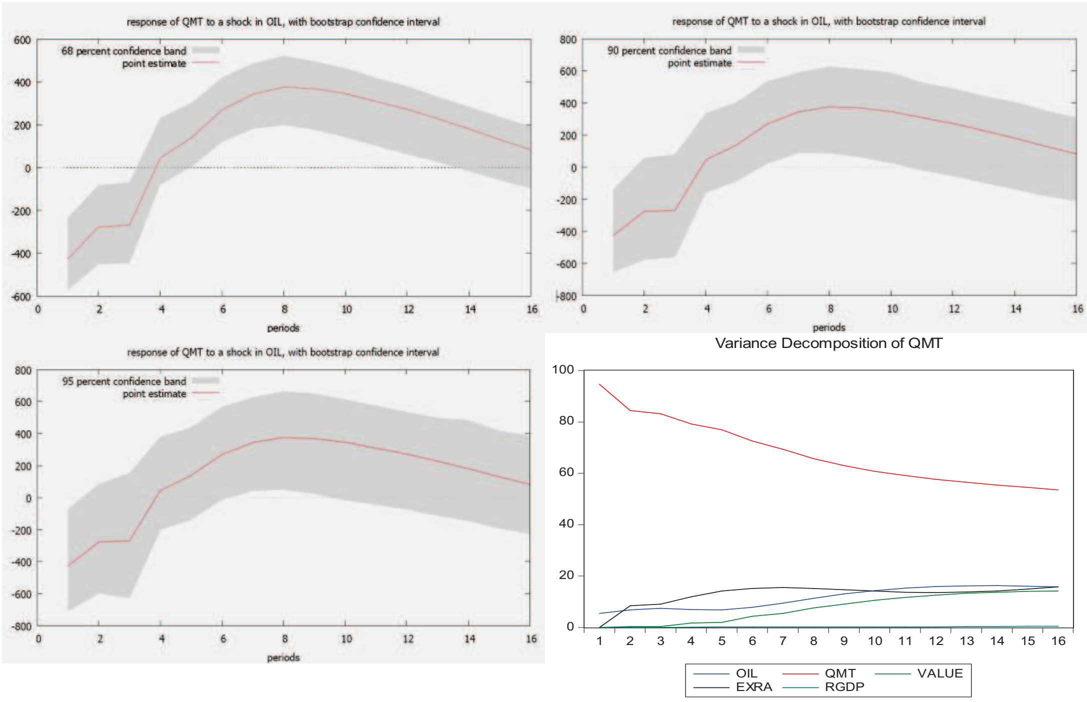
RGDP

19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OIL
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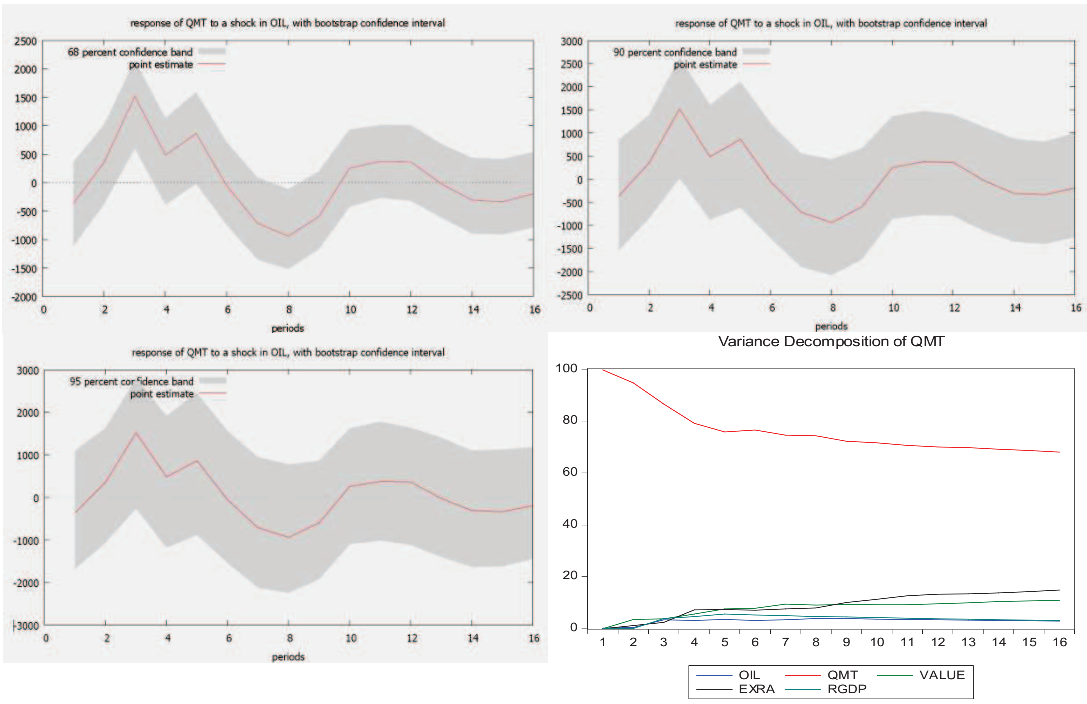
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Variance Decomposition of QMT
OIL
QMT
VALUE
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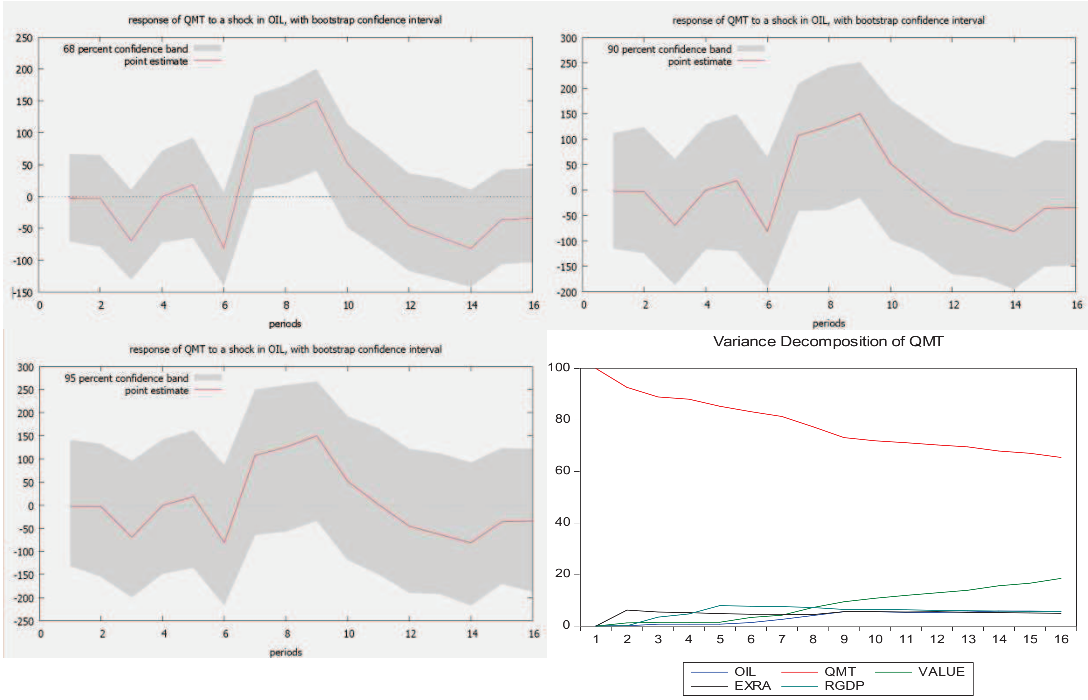
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95 percent confidence band
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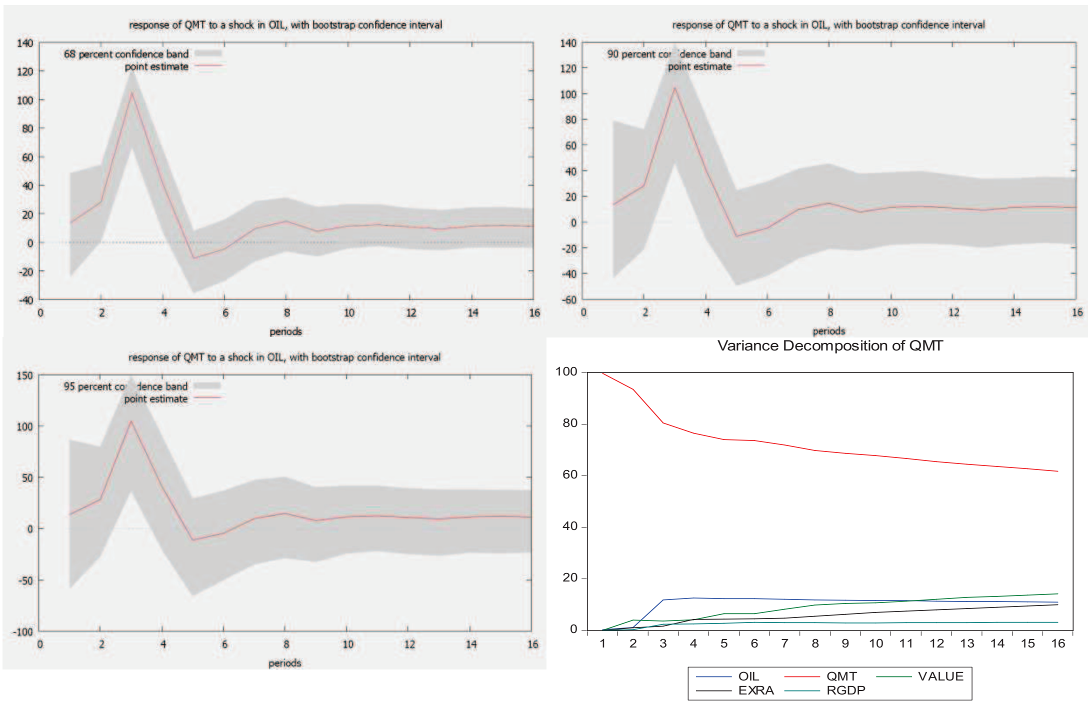
OIL
QMT
VALUE
EXRA
RGDP

21B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OIL
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RGDP

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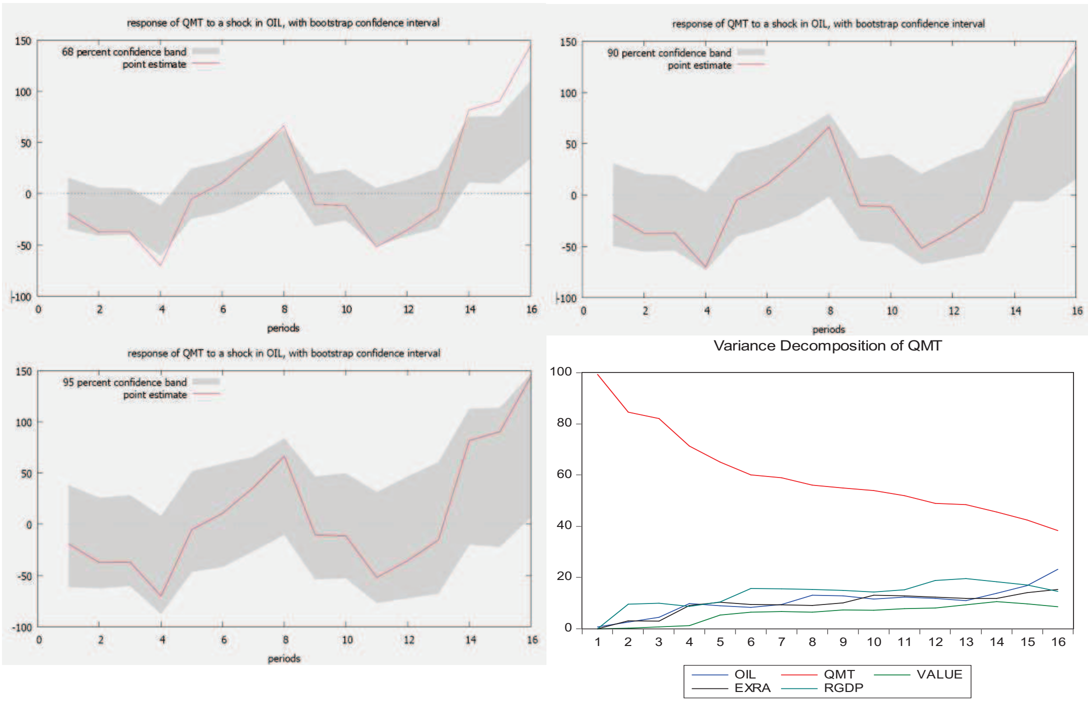
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Variance Decomposition of QMT
OIL
QMT
VALUE
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RGDP

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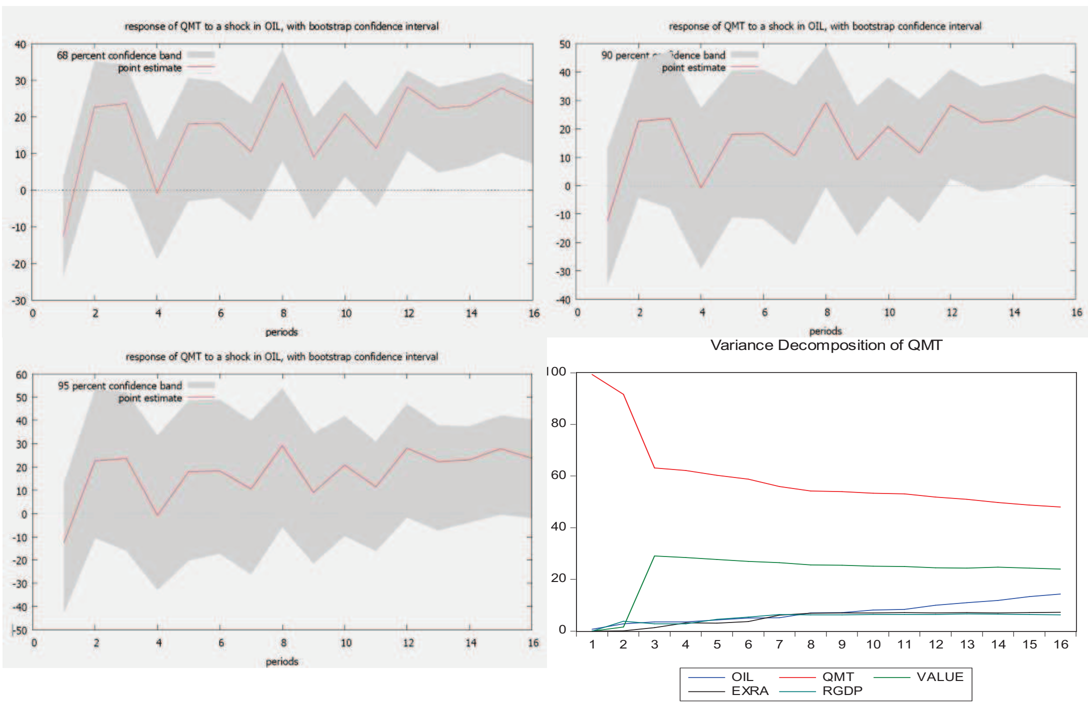
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Variance Decomposition of QMT
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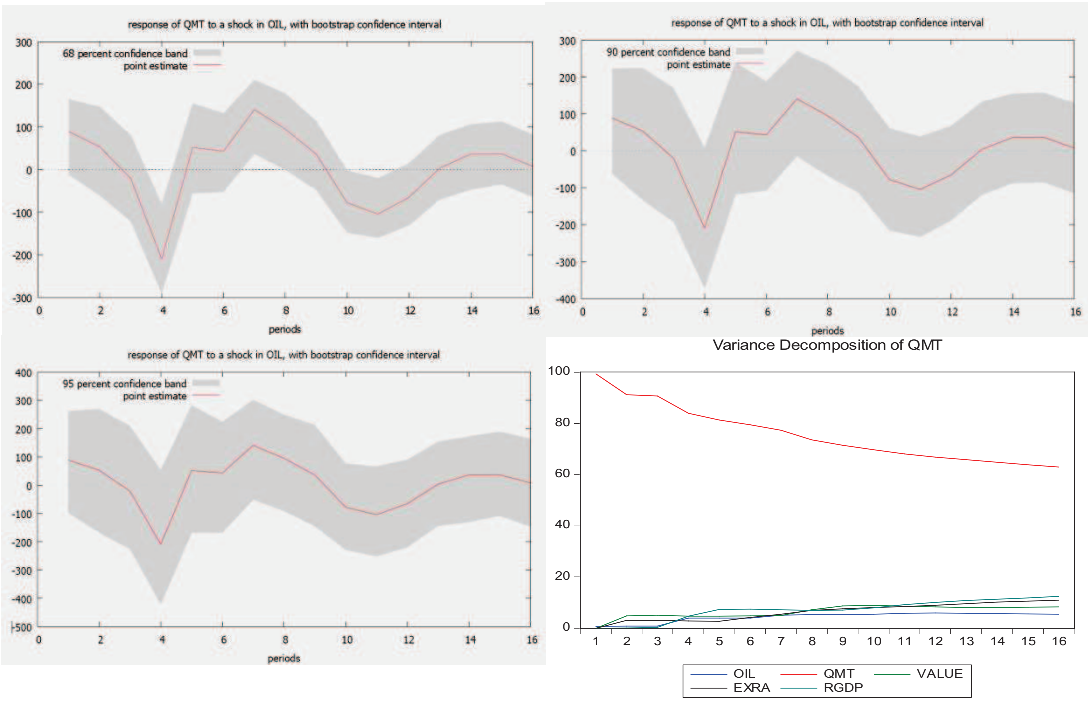
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OIL
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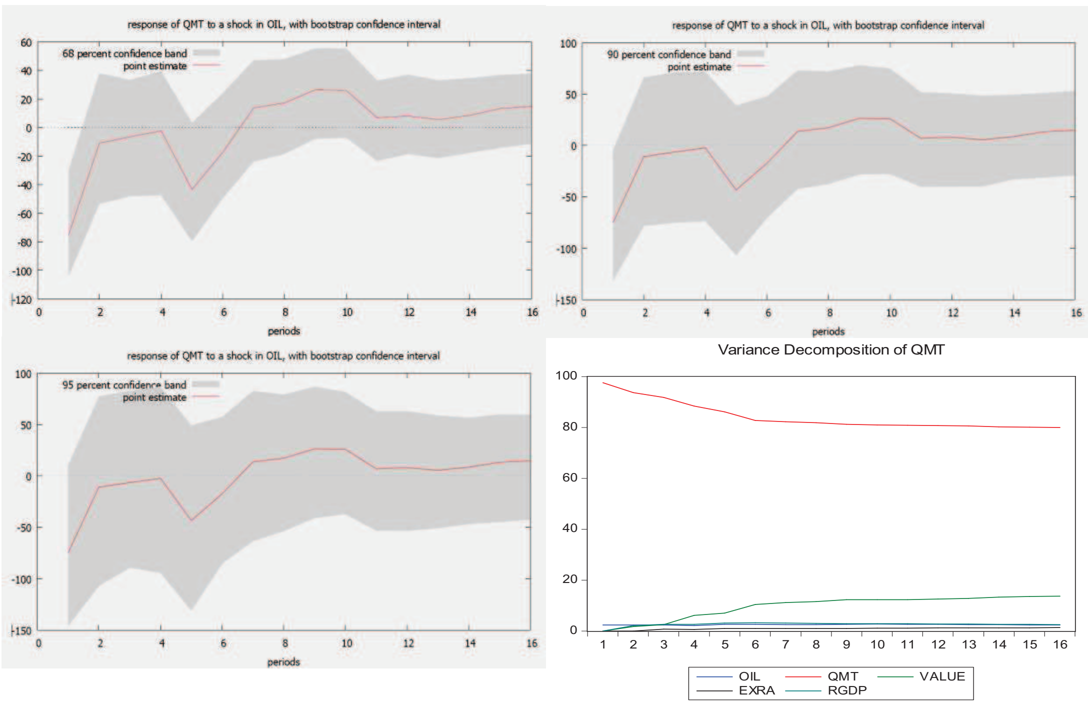
22B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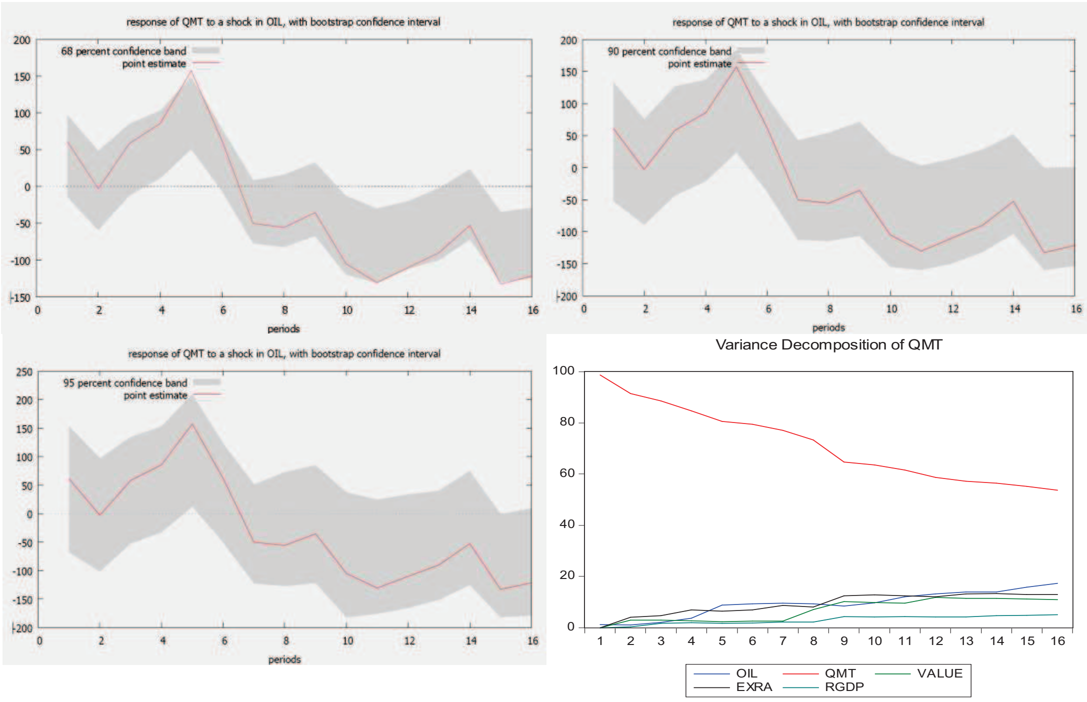
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Variance Decomposition of QMT
OIL
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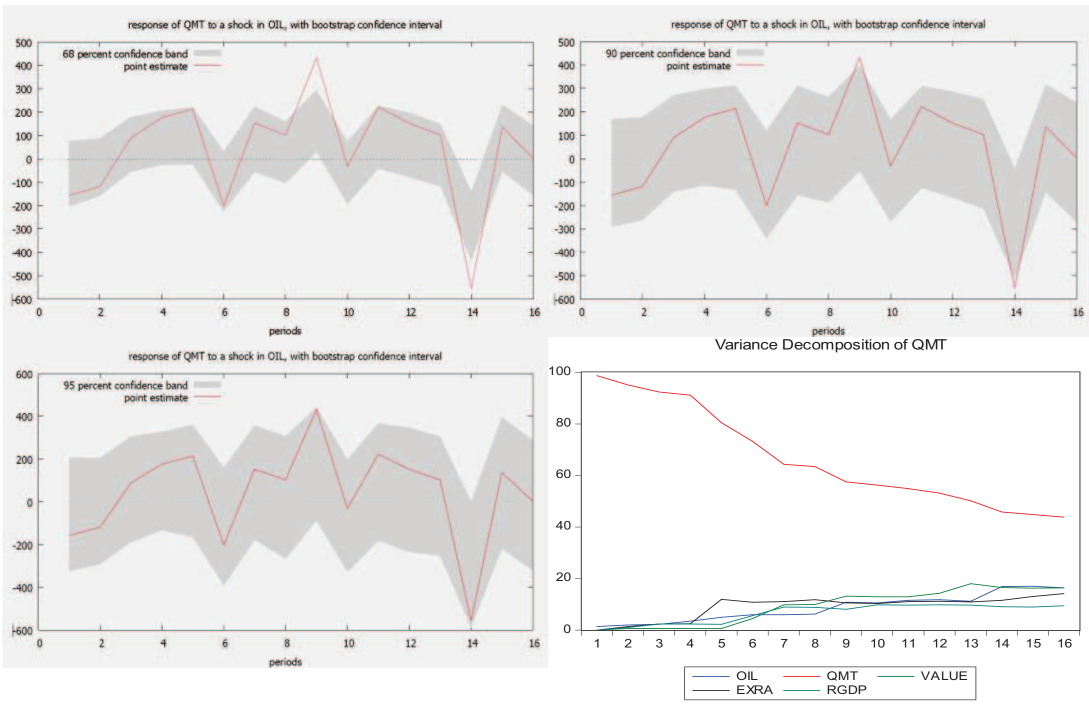
RGDP

28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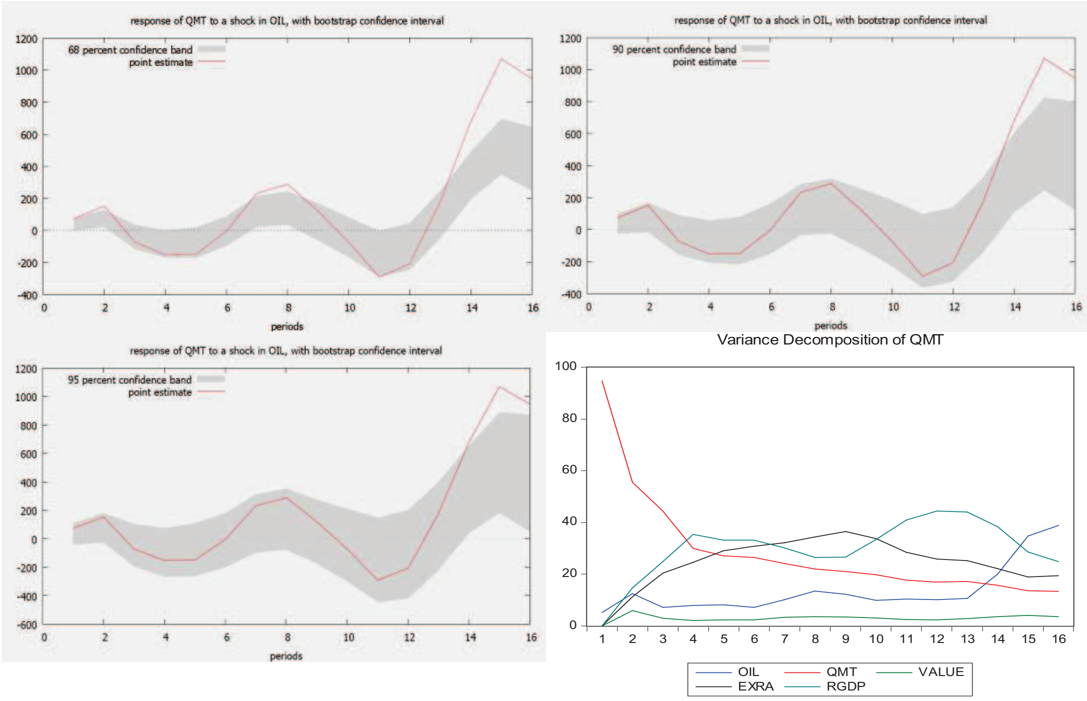
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Variance Decomposition of QMT
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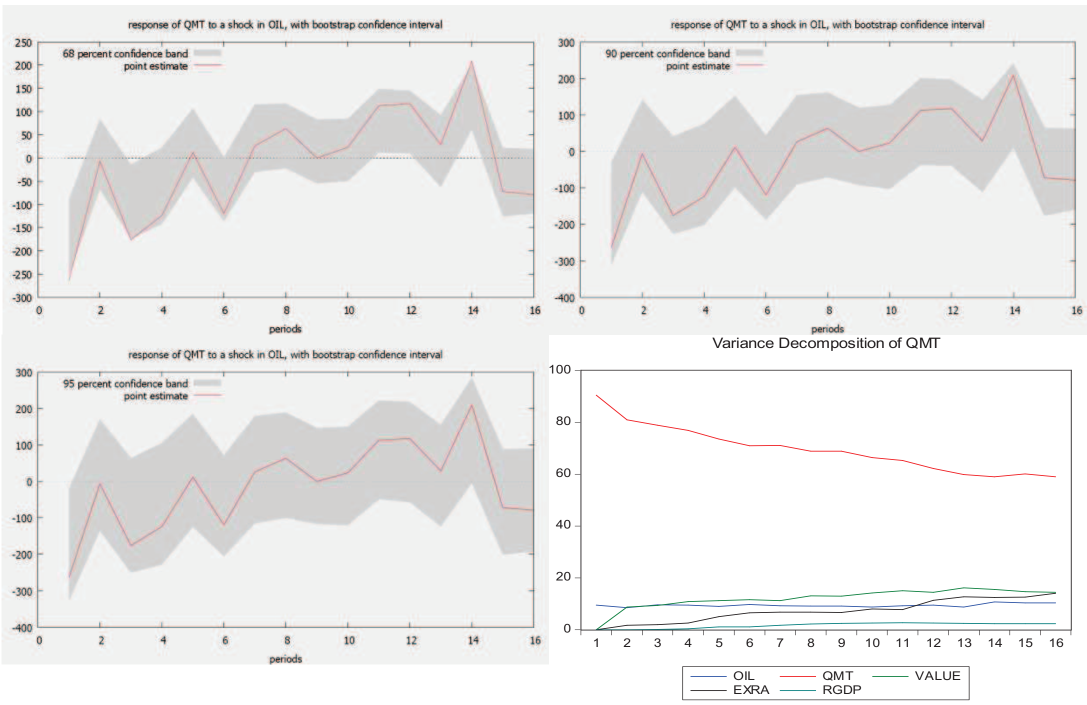
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Variance Decomposition of QMT
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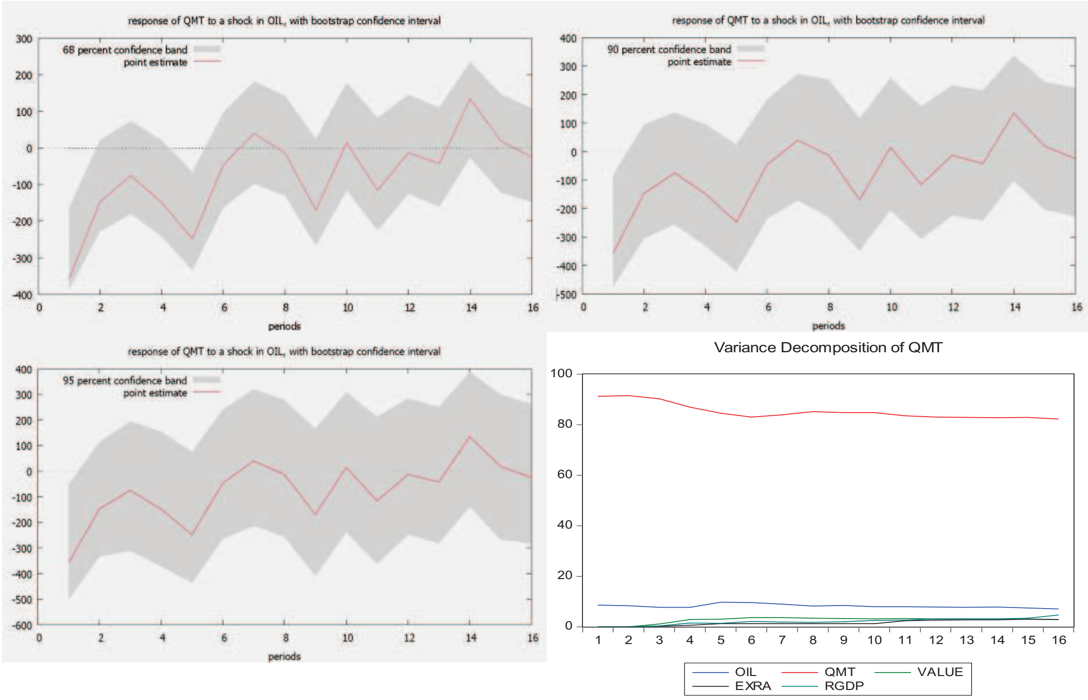
RGDP

31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Variance Decomposition of QMT
OIL
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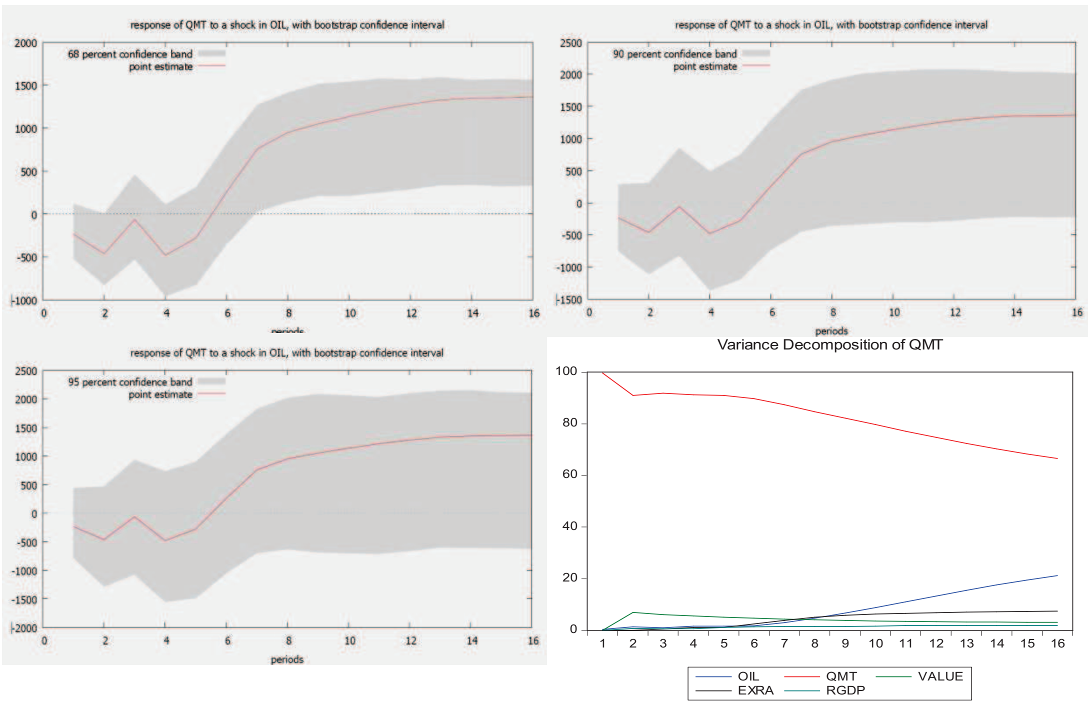
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OIL
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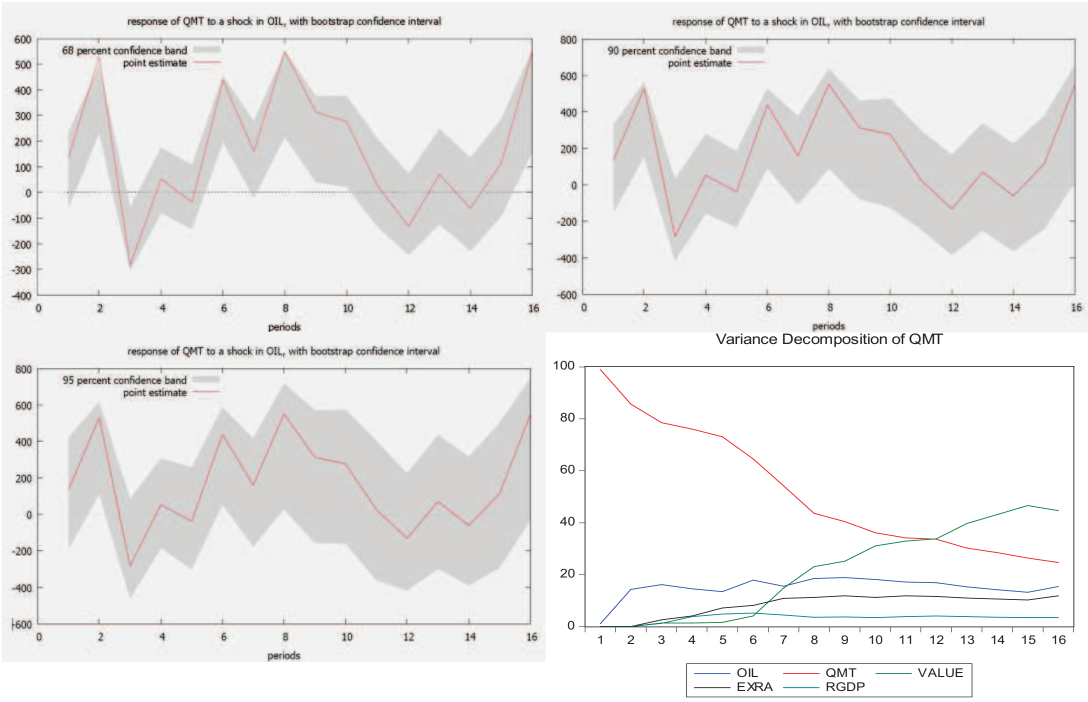
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Variance Decomposition of QMT
OIL
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RGDP

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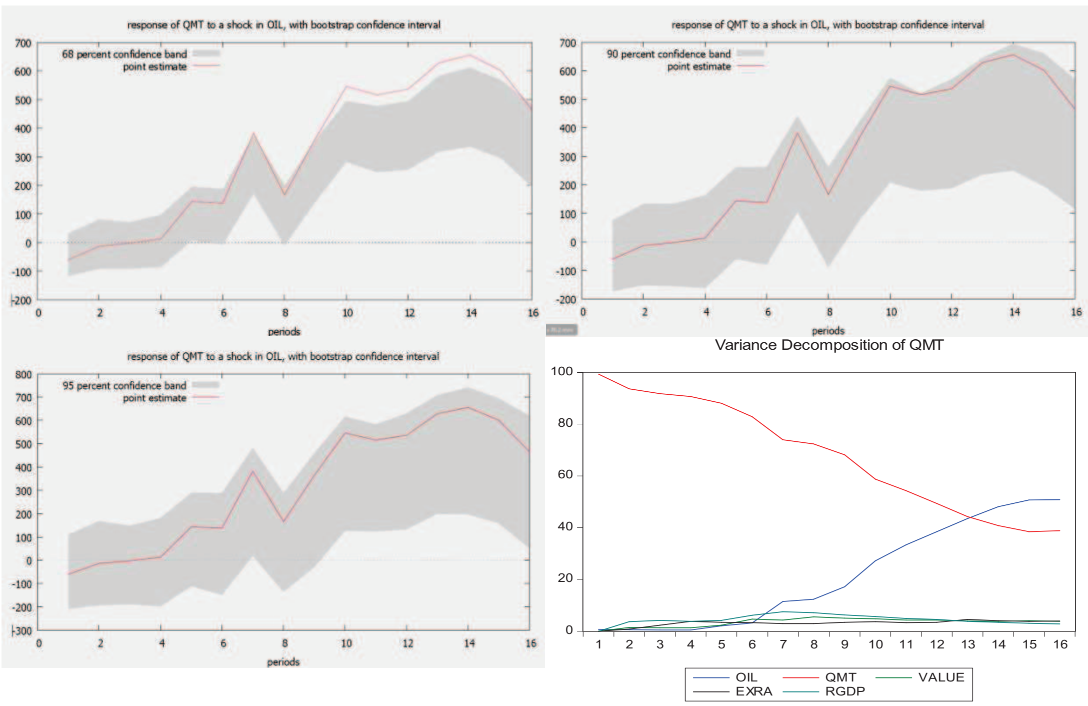
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Variance Decomposition of QMT
OIL
QMT
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RGDP

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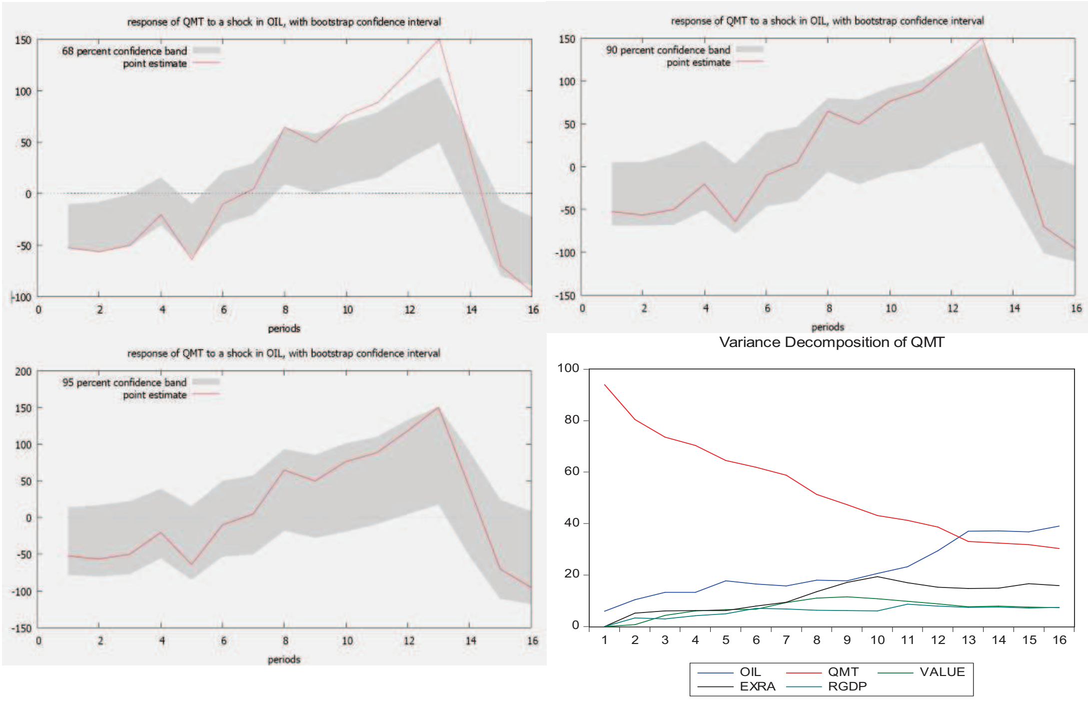
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OIL
QMT
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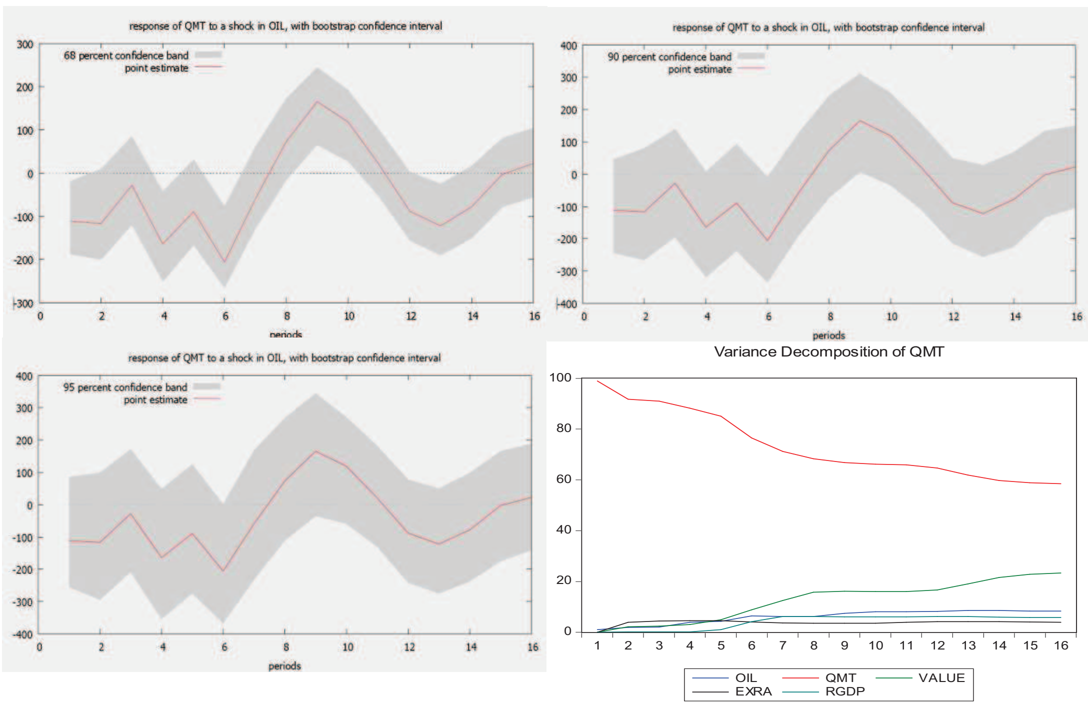
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OIL
QMT
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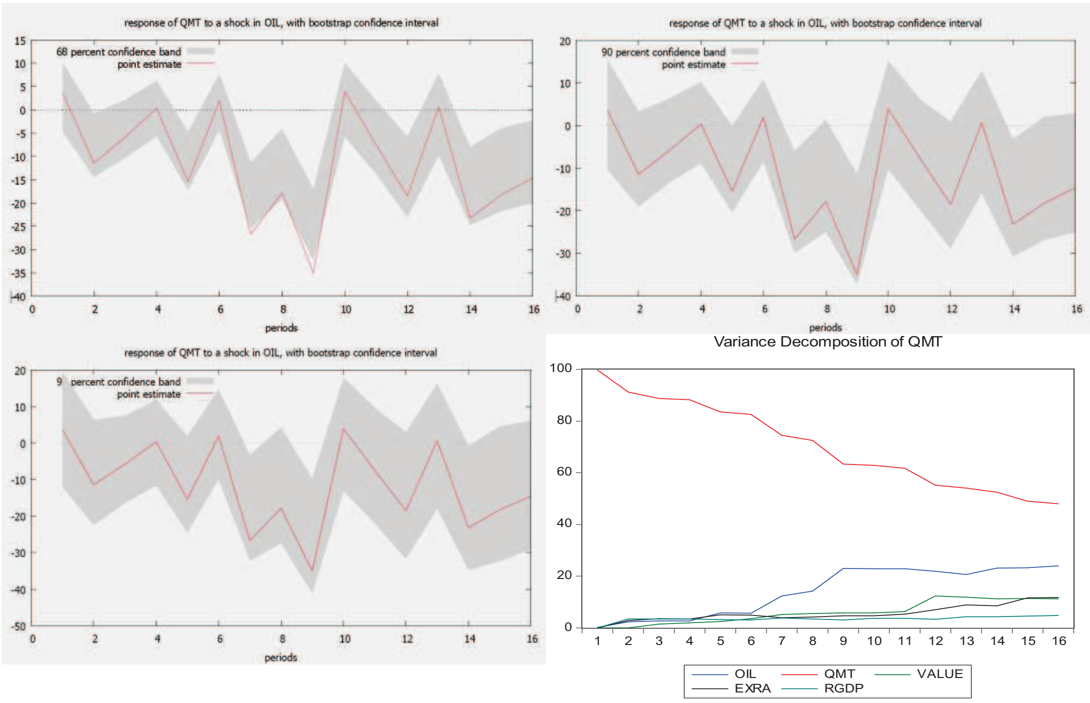
RGDP

36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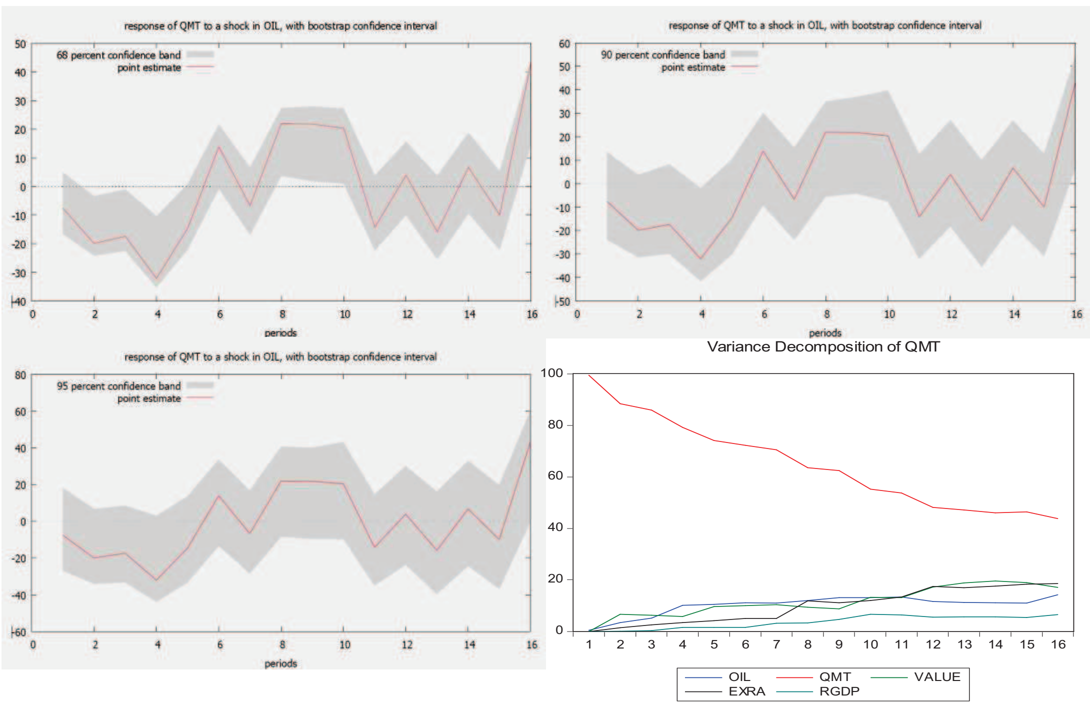
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

37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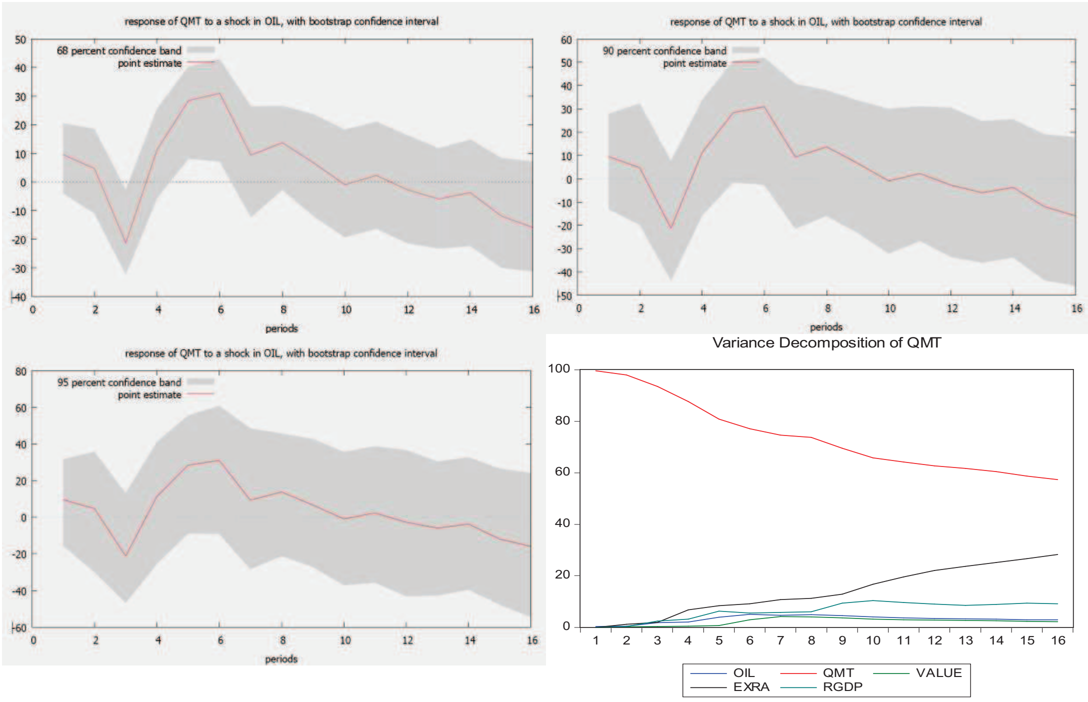
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

4.2.7.3 South Korea

1B



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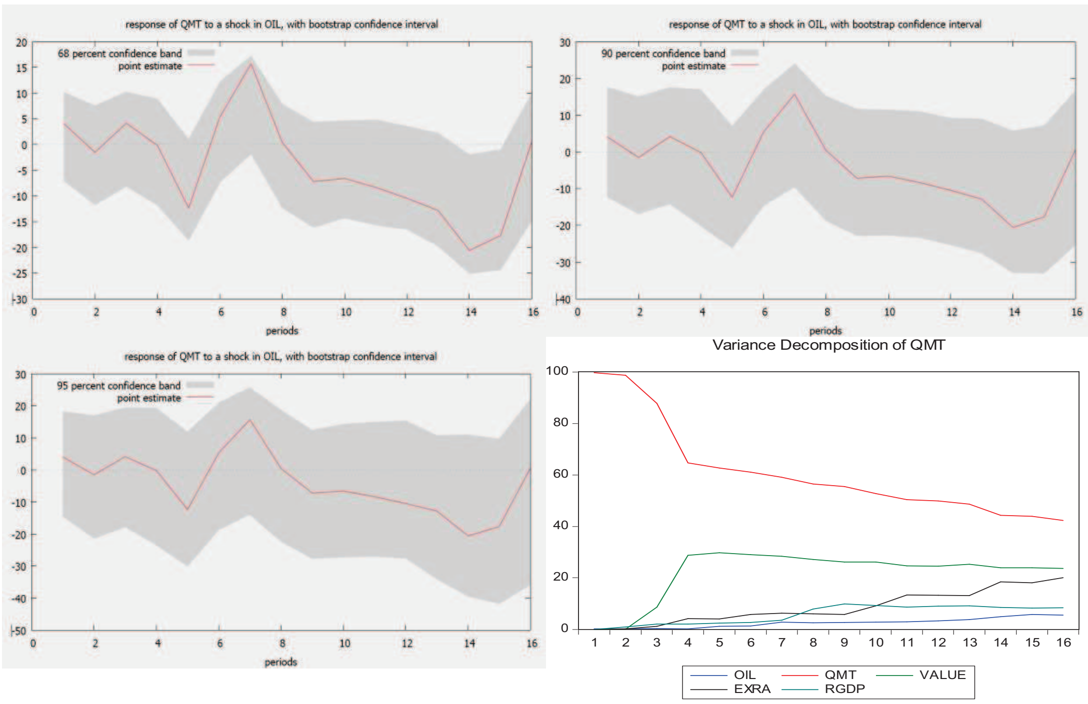

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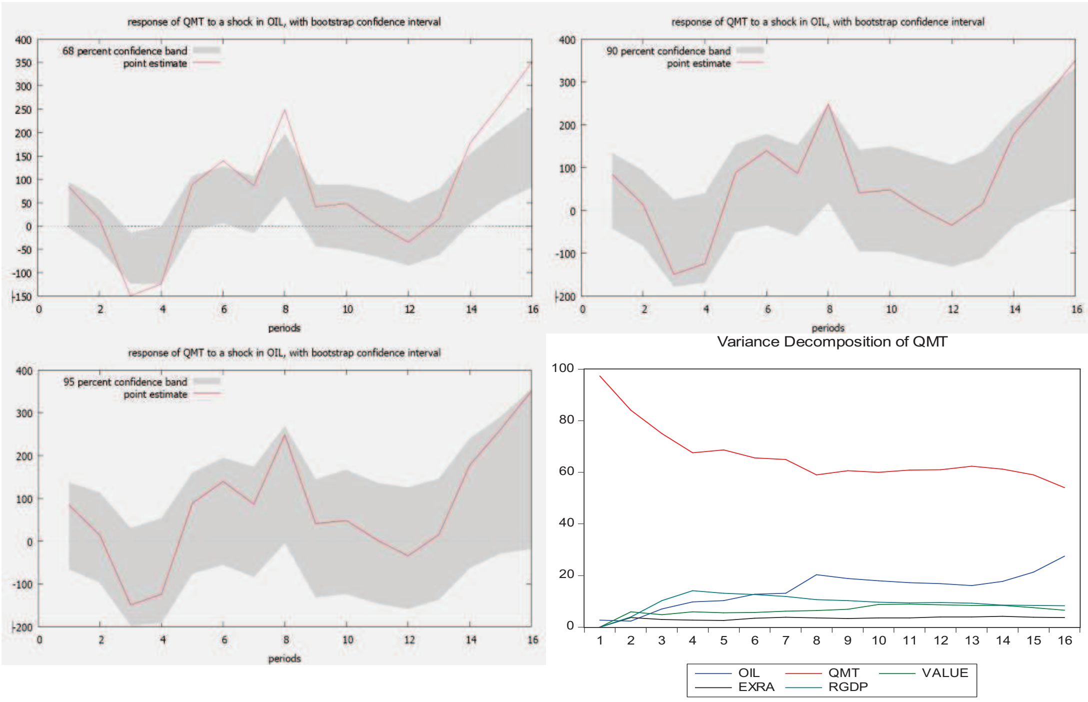
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QMT
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EXRA
RGDP

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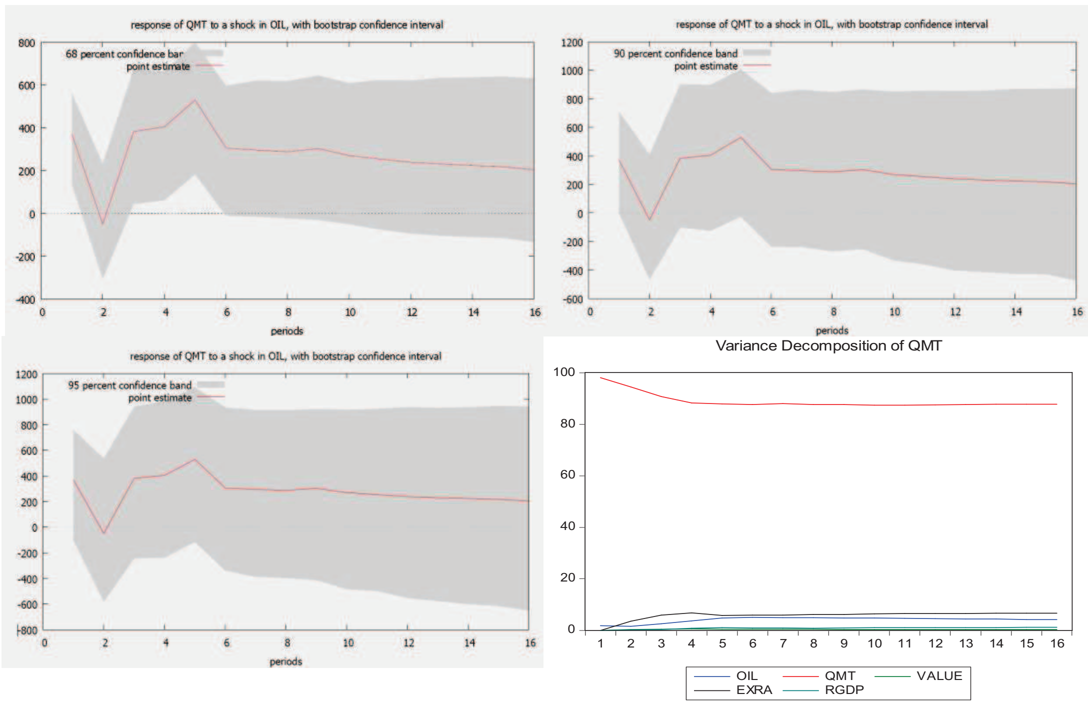
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point estimate
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90 percent confidence band
point estimate
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OIL
QMT
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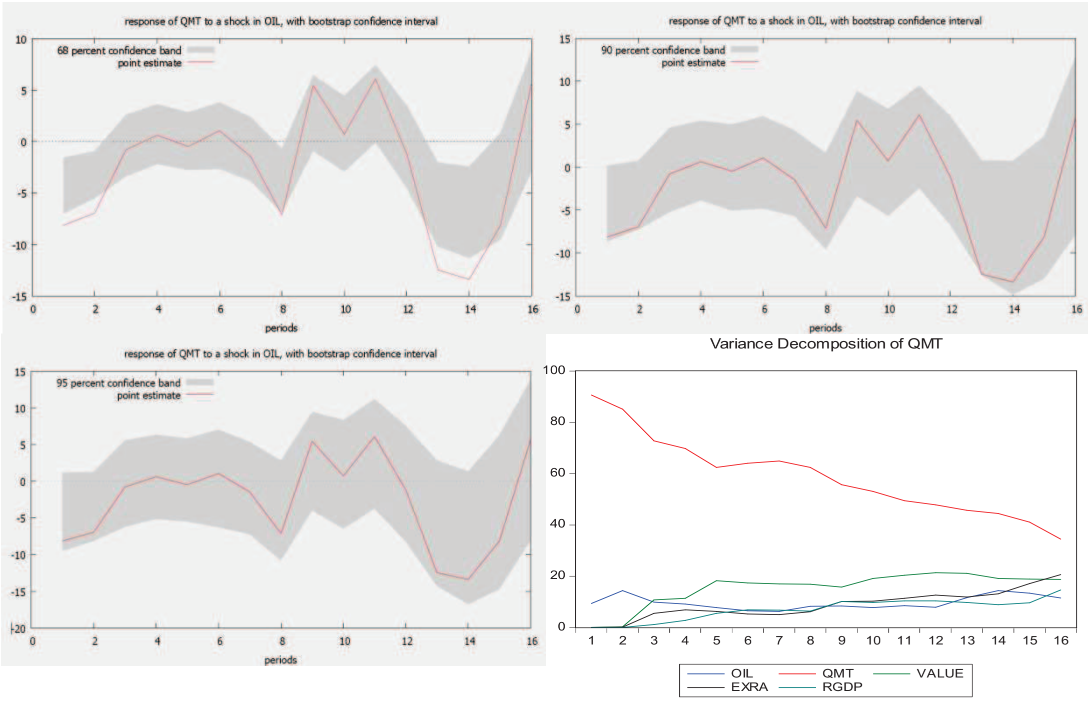
RGDP

6B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OIL
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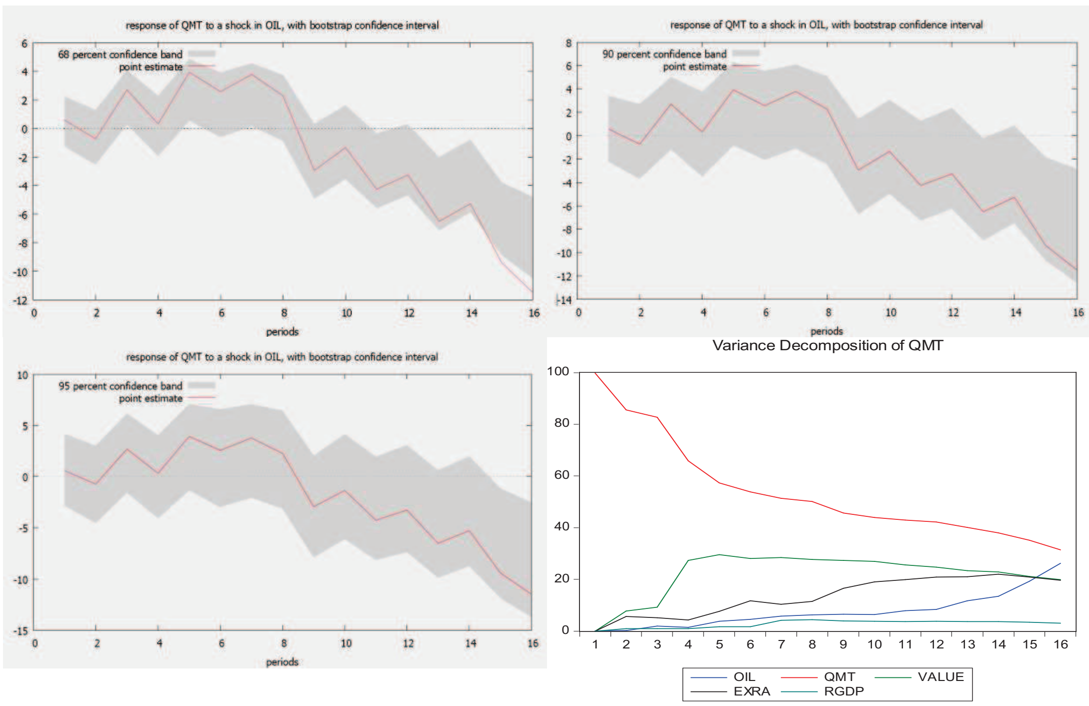
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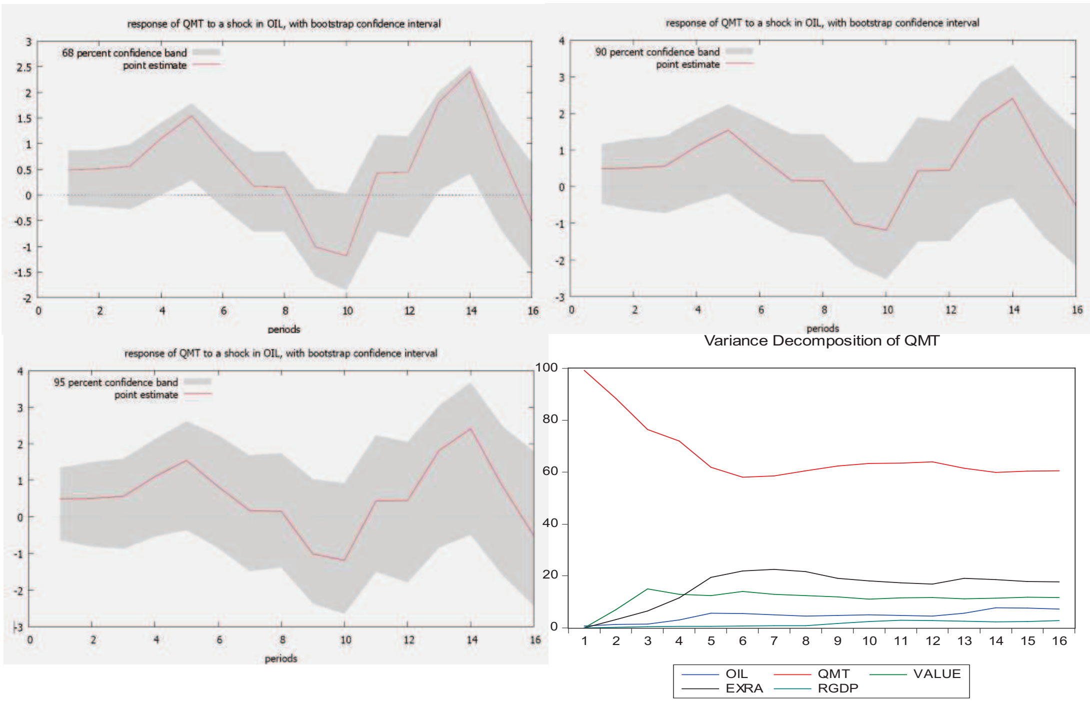
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OIL
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RGDP

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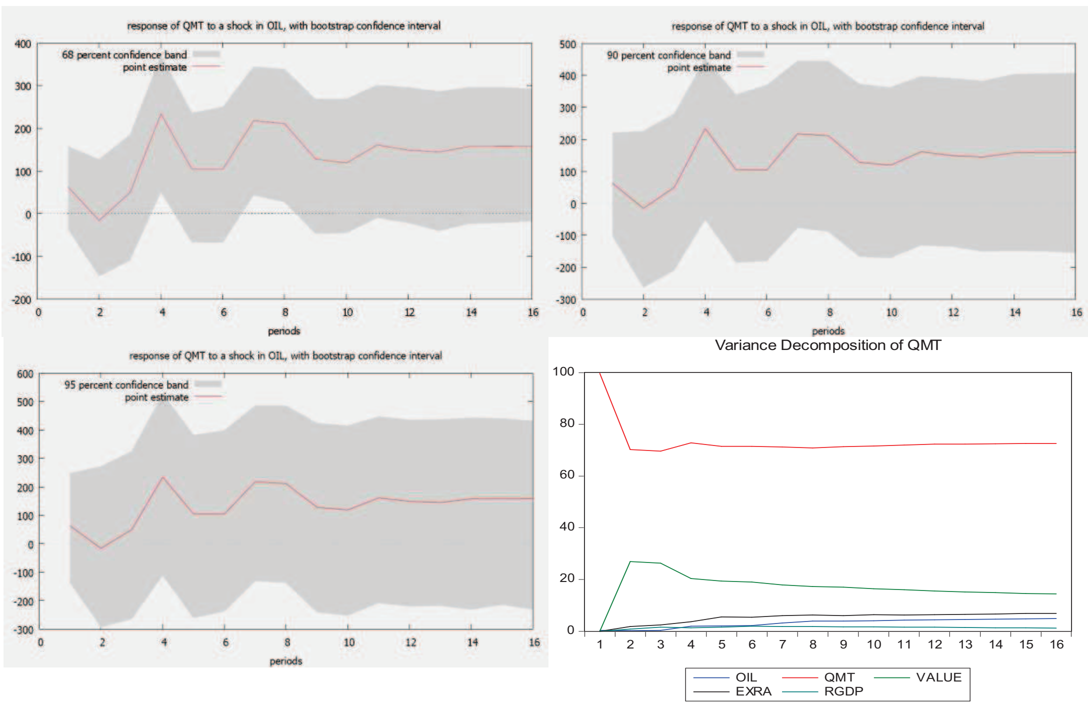
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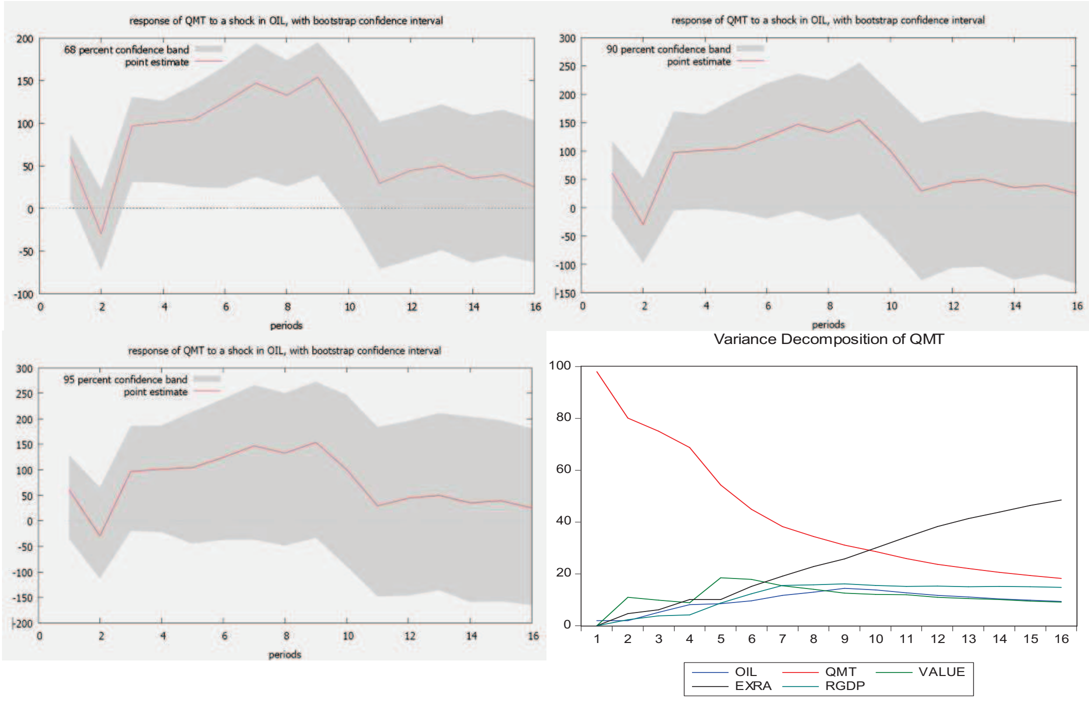
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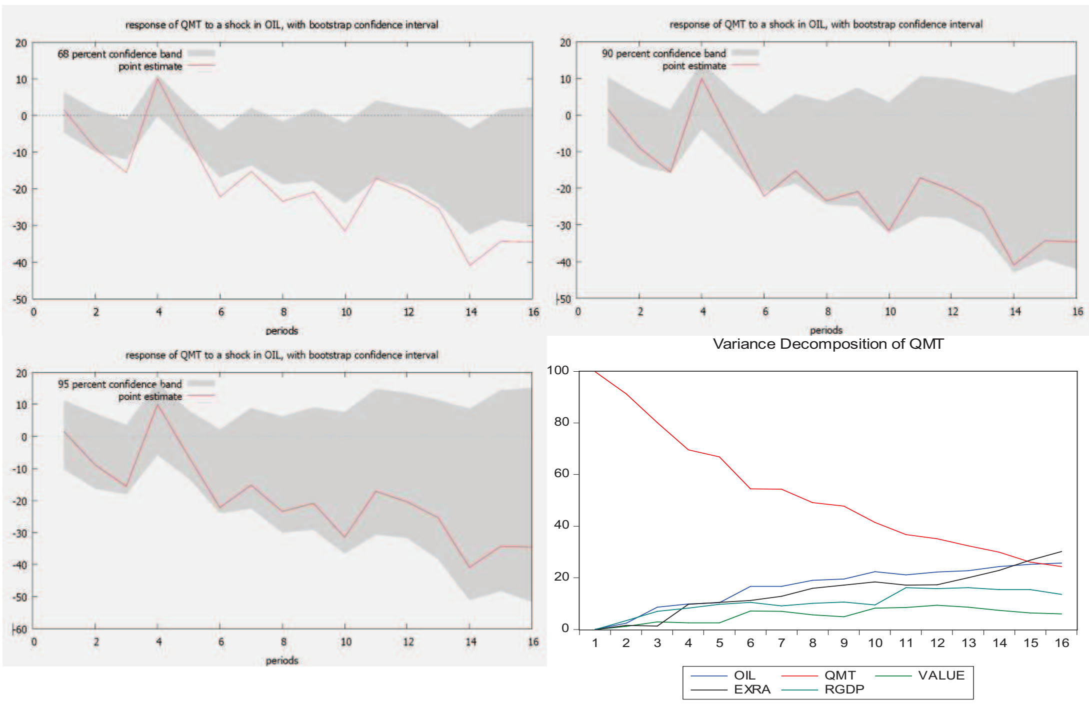
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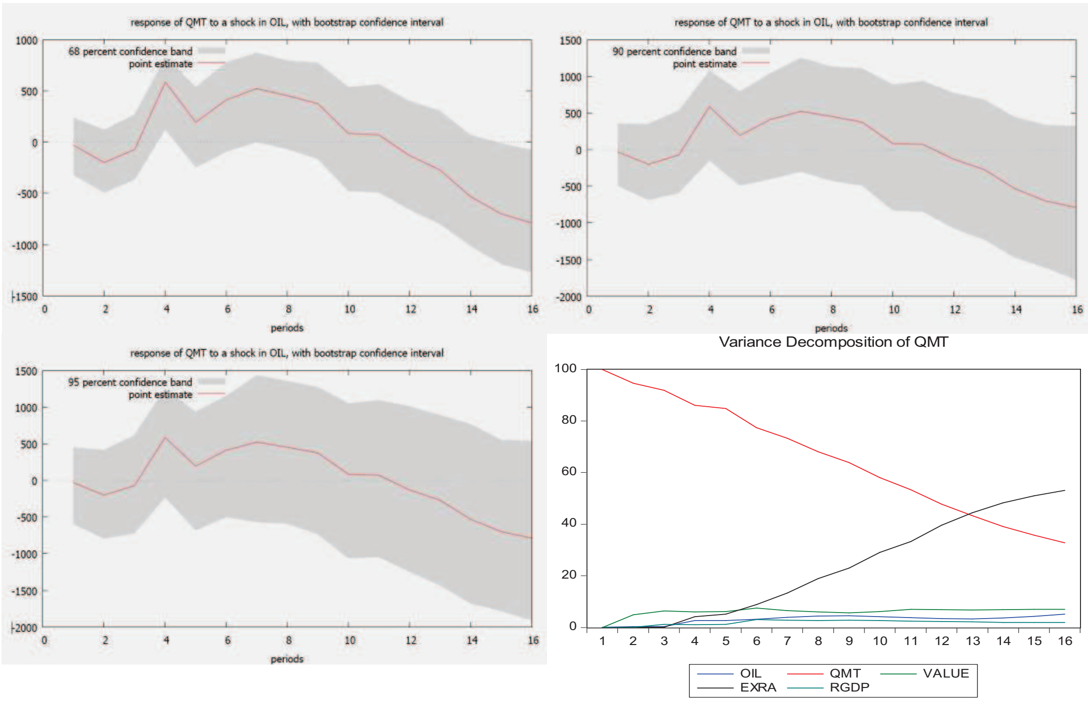
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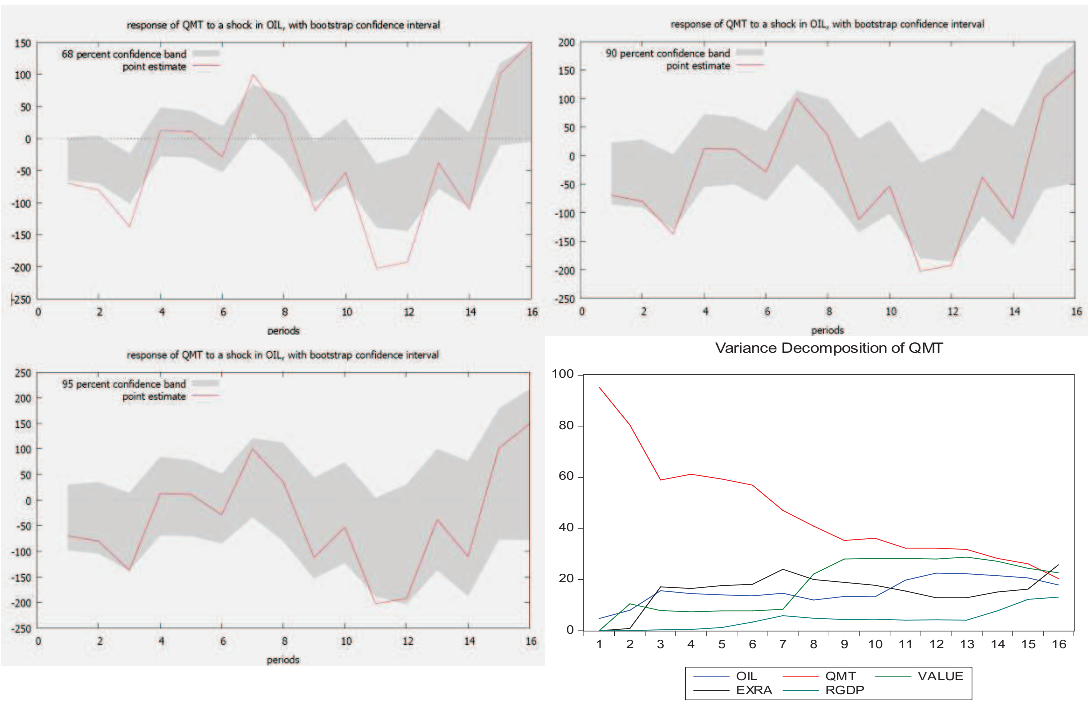
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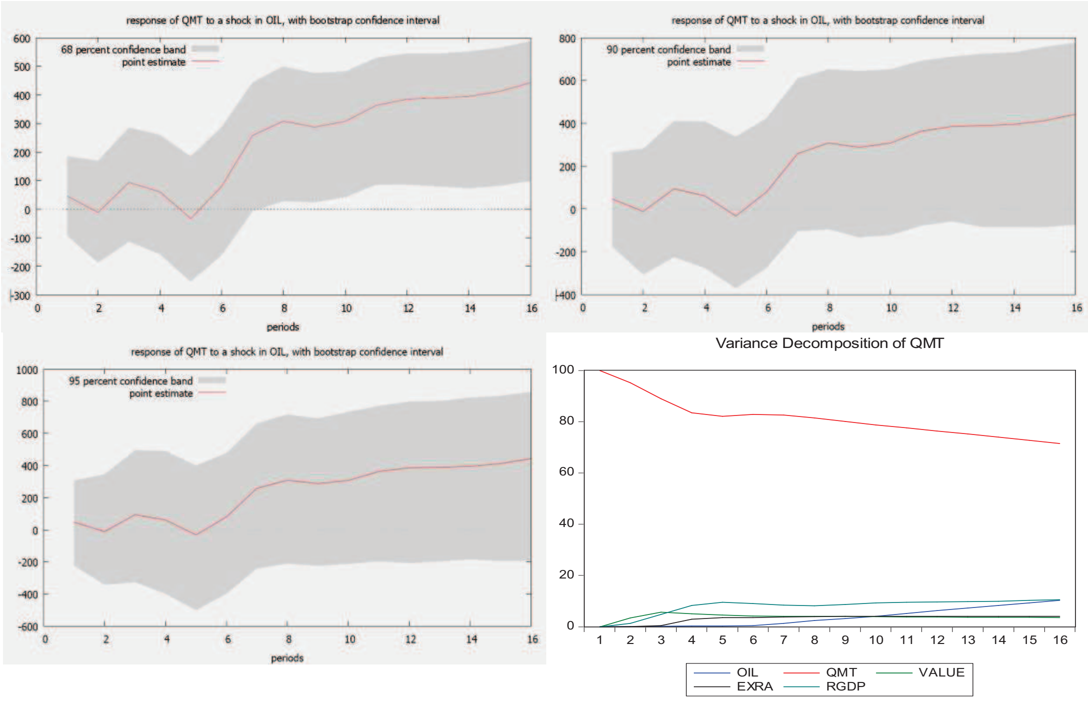
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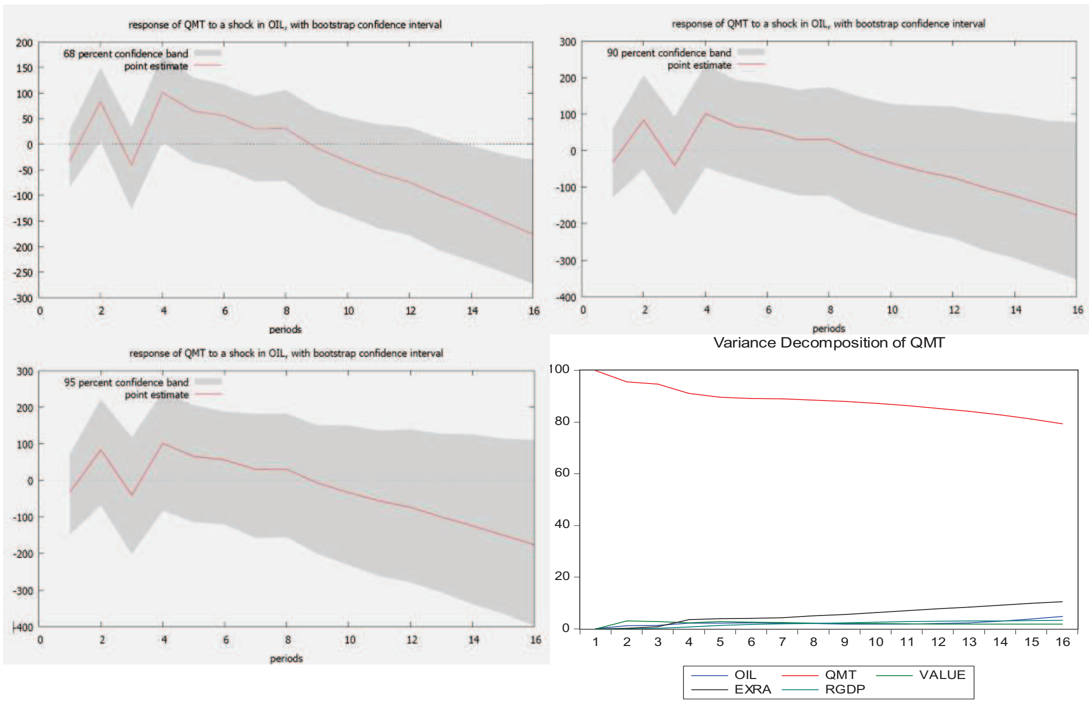
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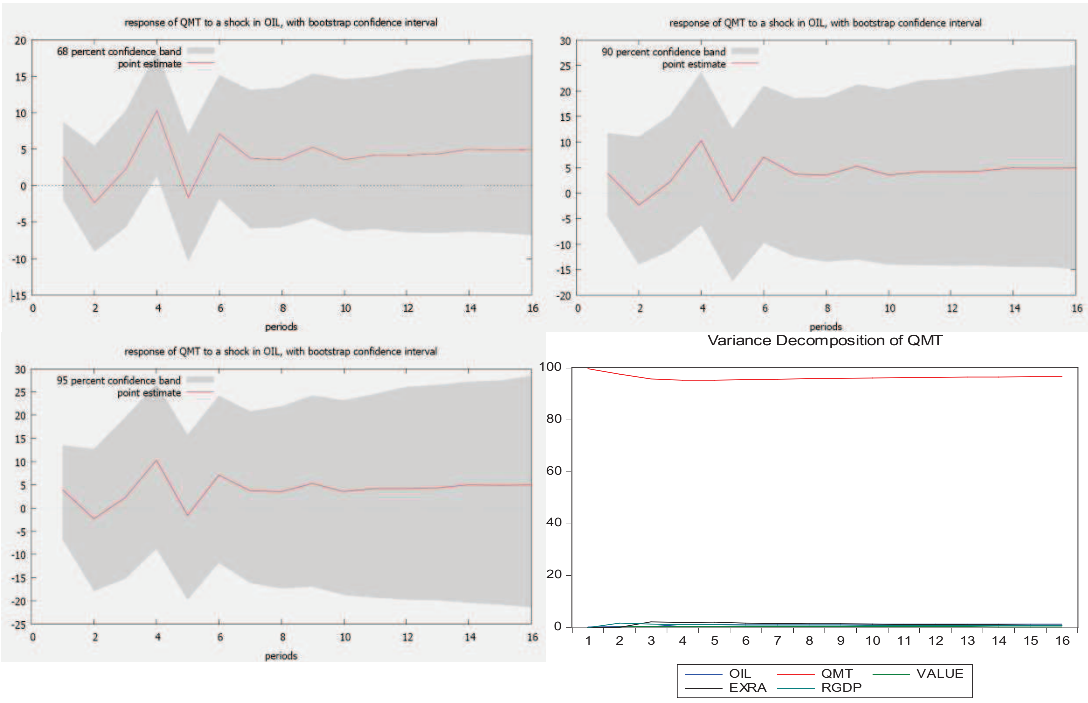
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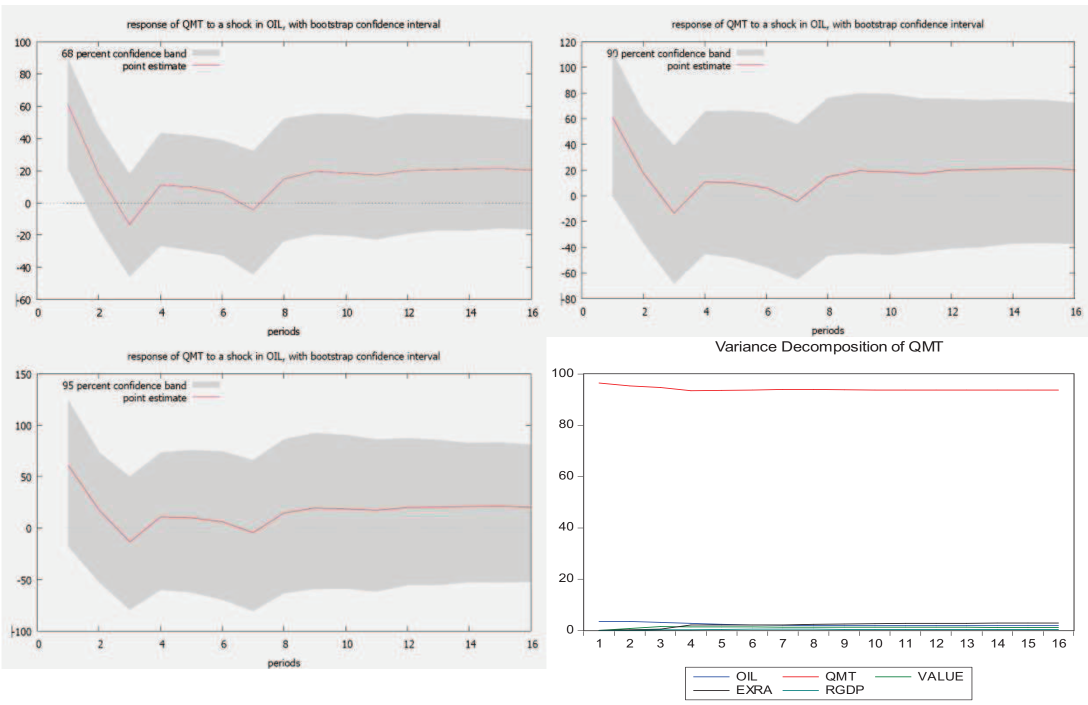
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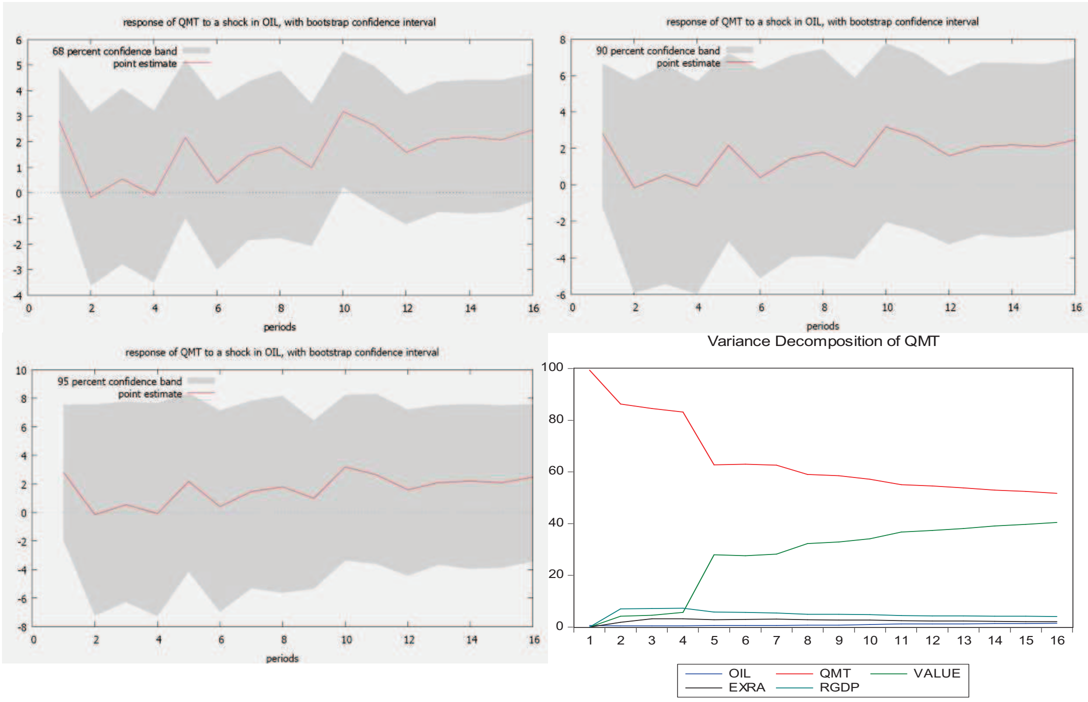
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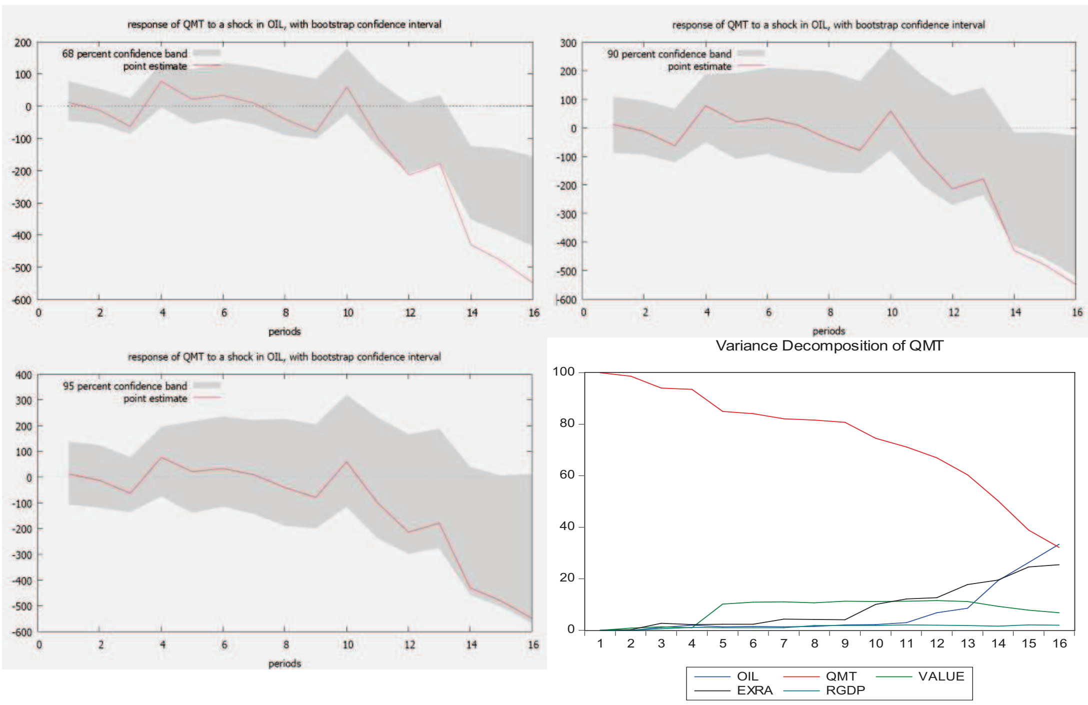
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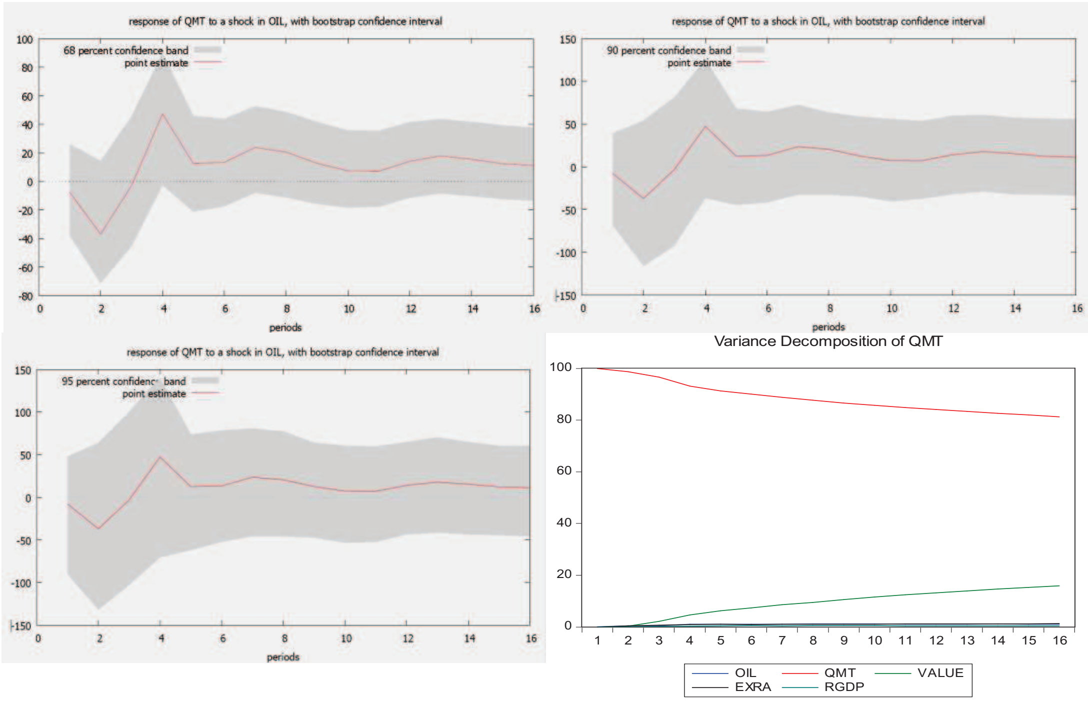
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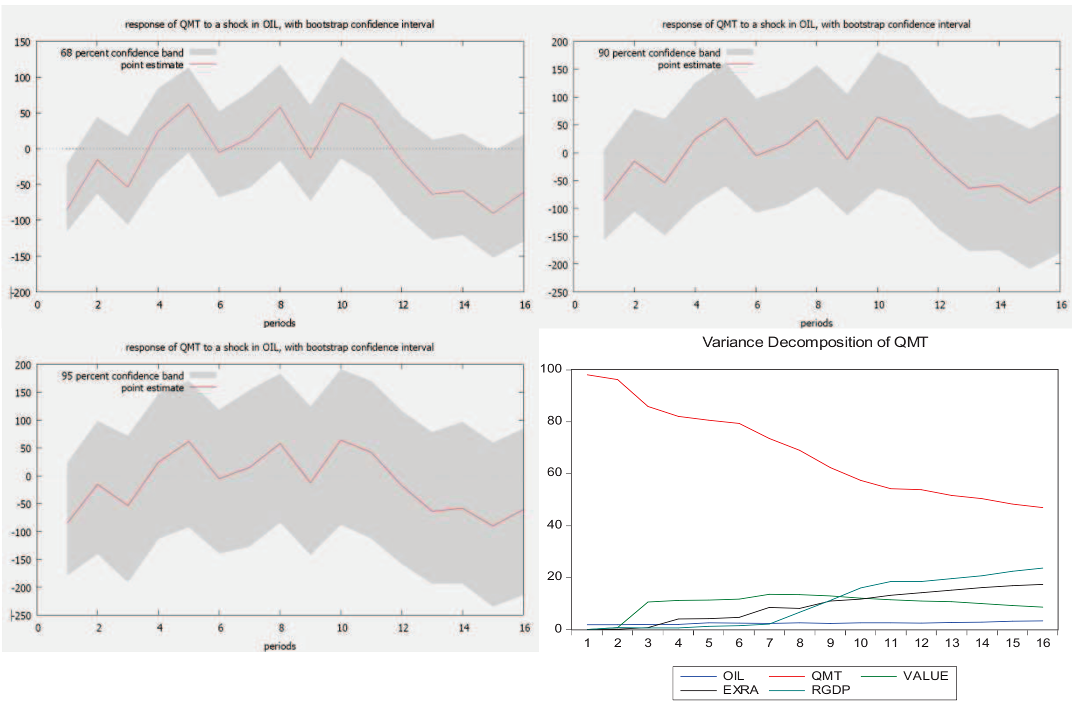
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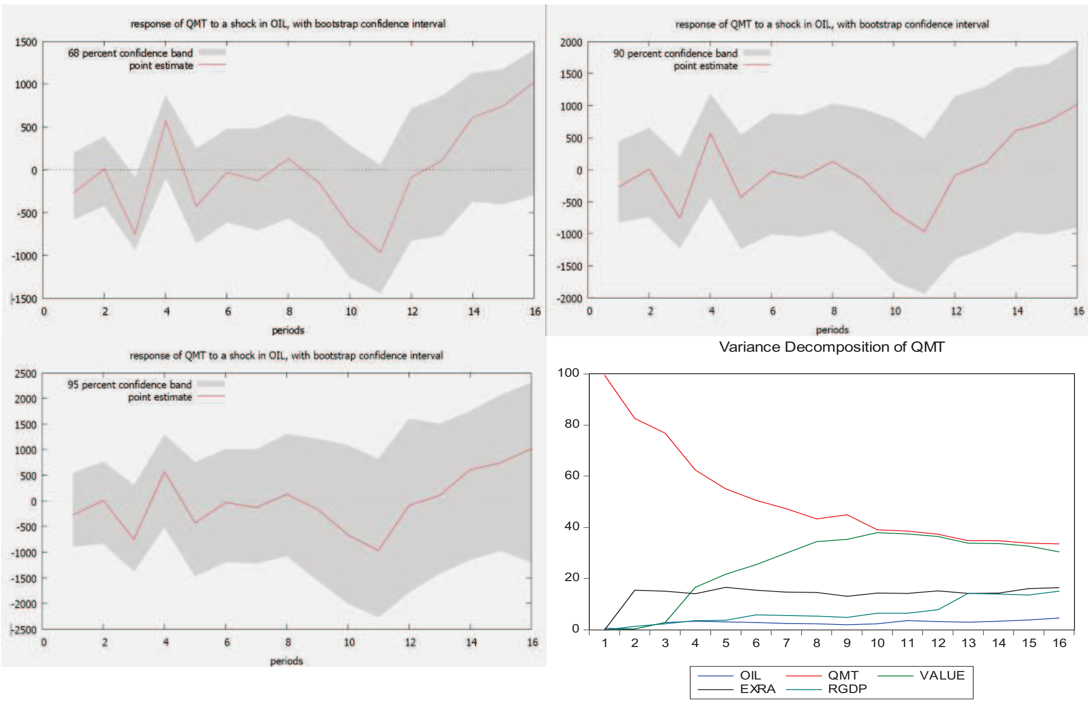
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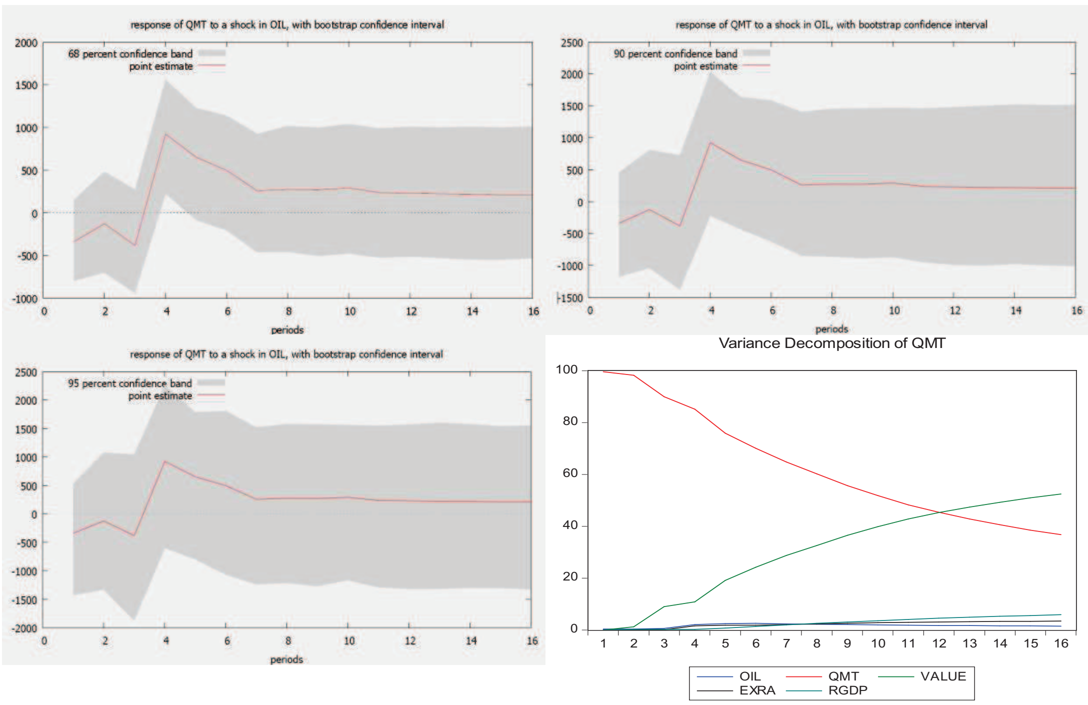
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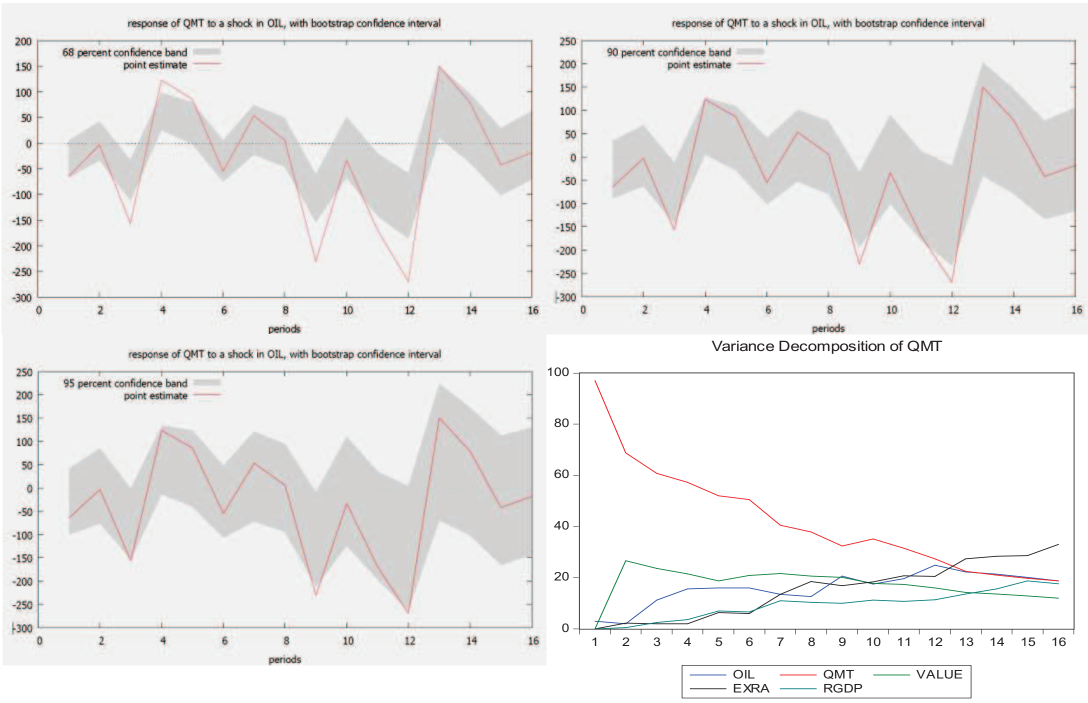
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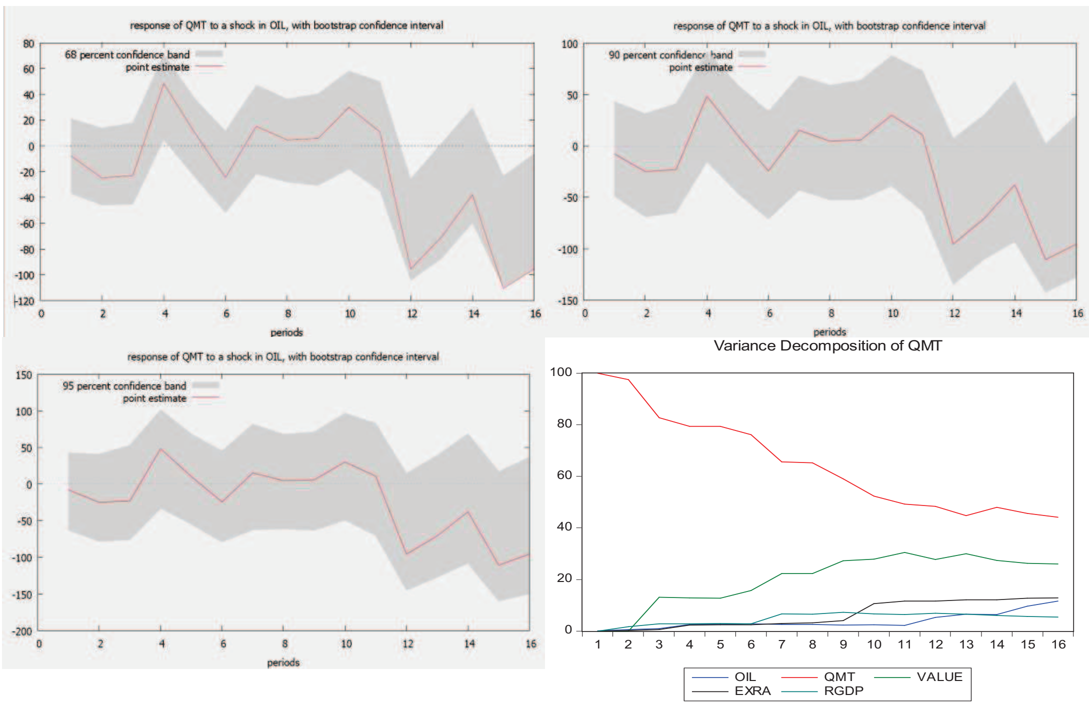
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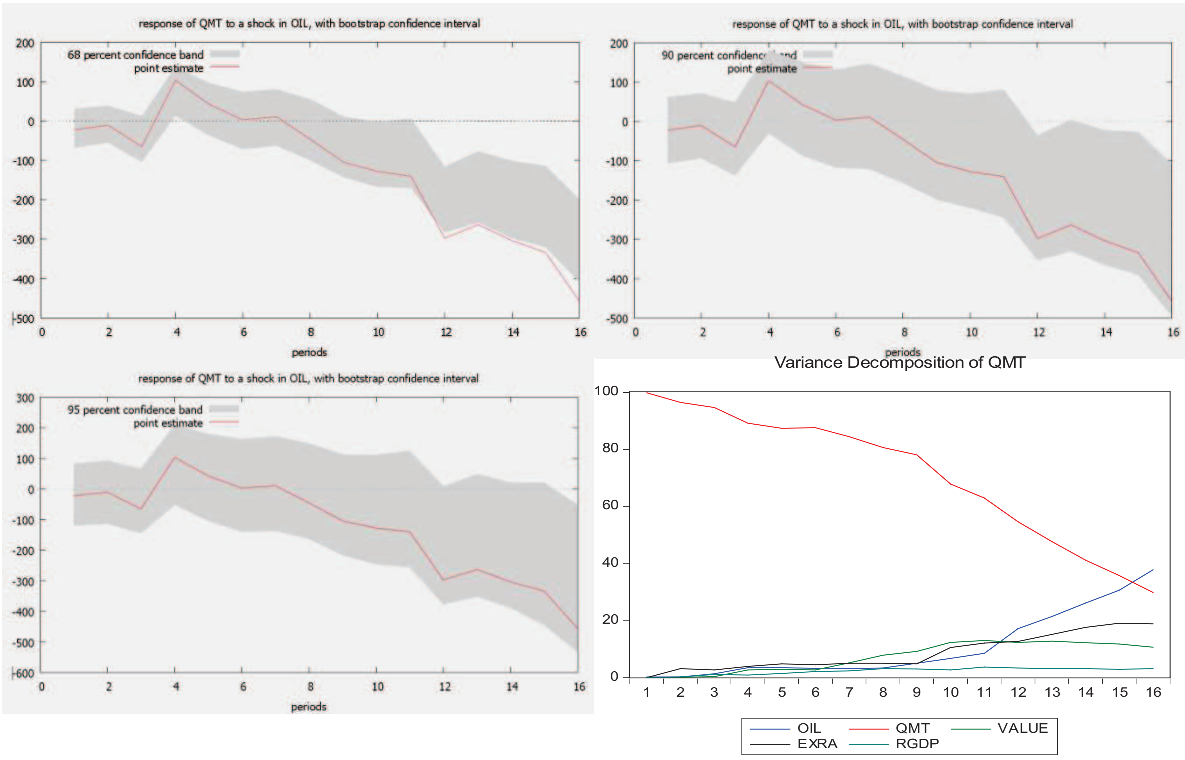
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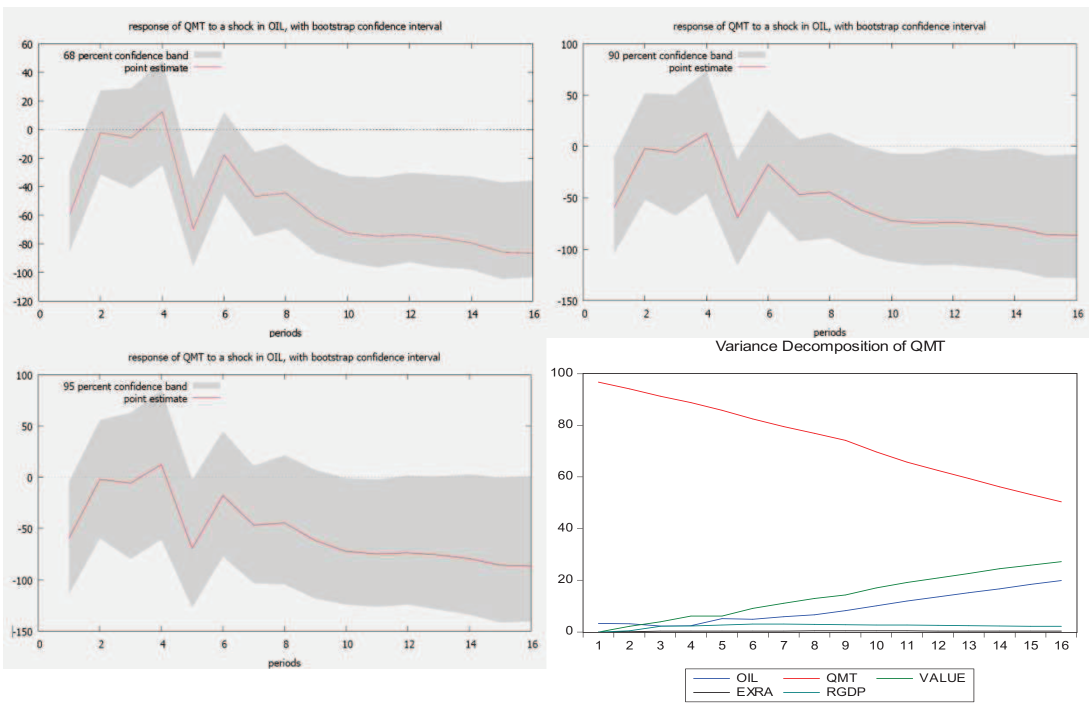
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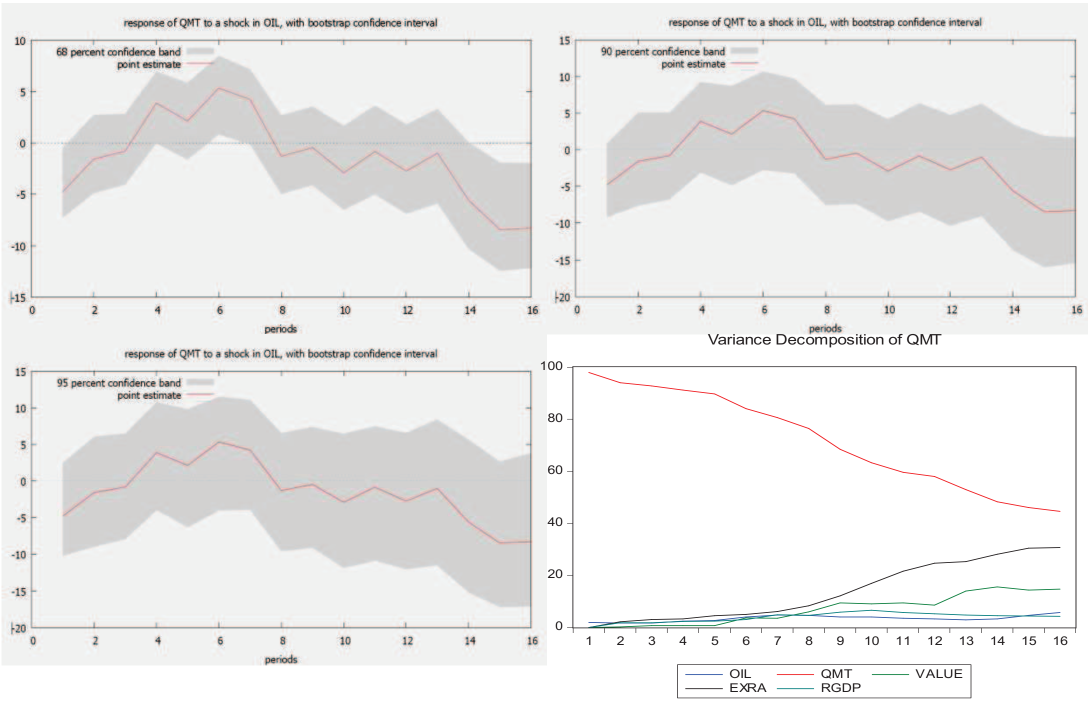
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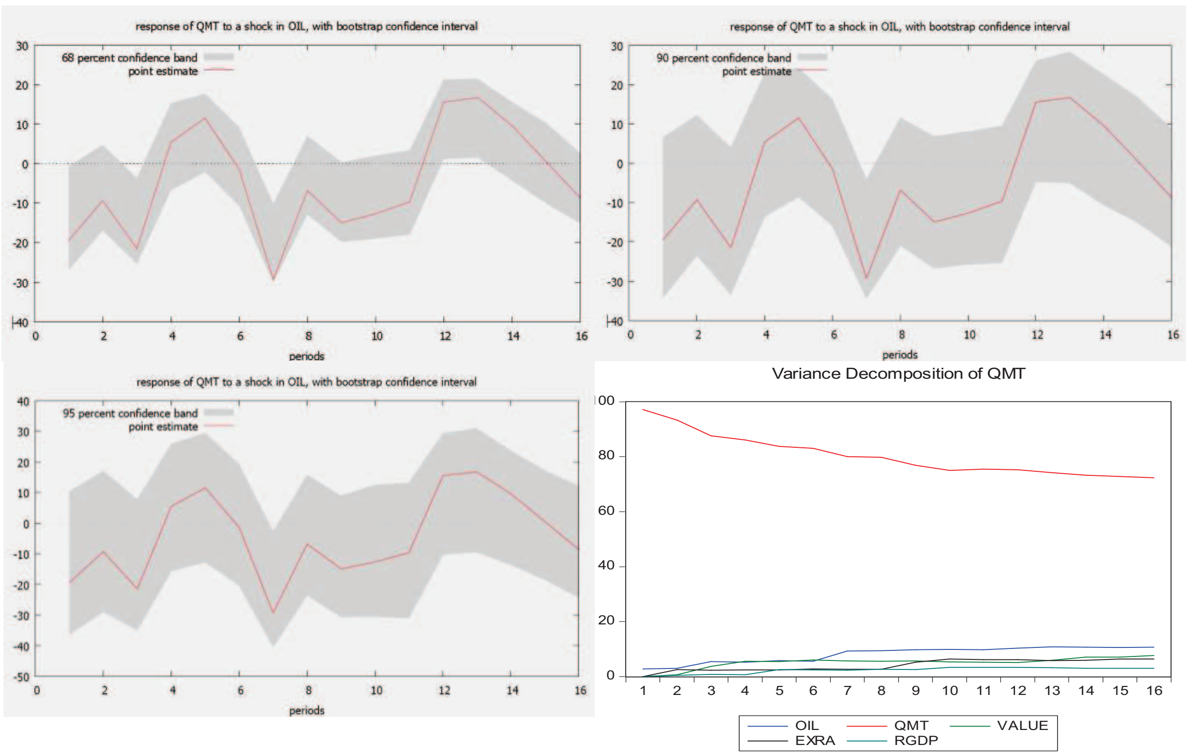
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4.2.7.4 Taiwan

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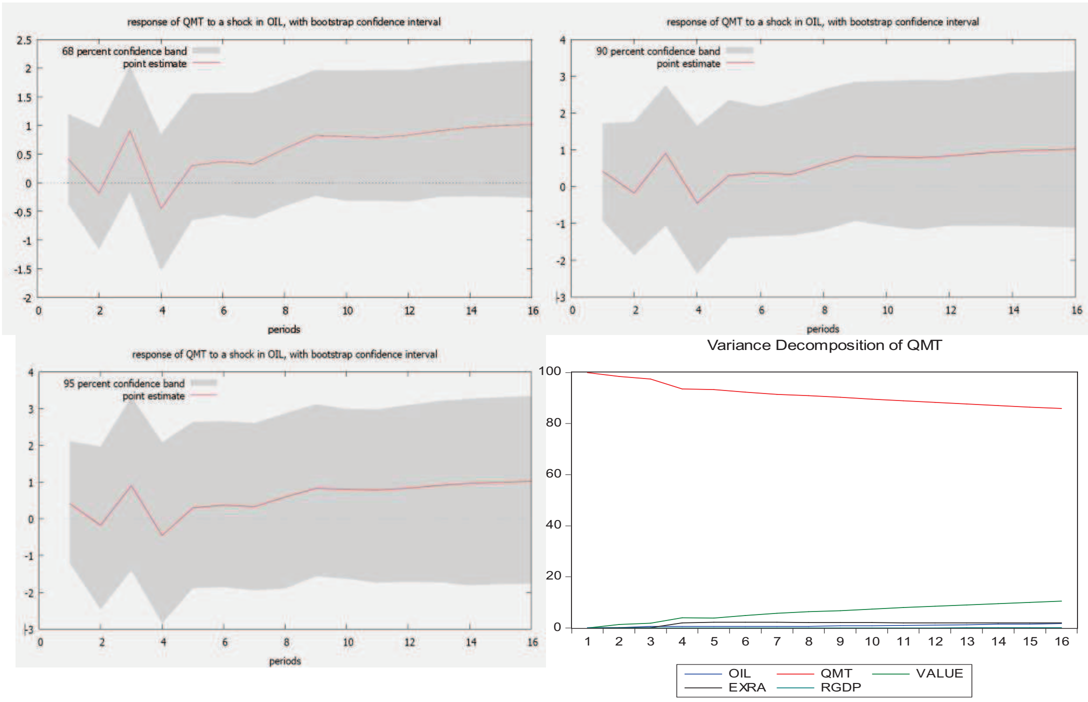

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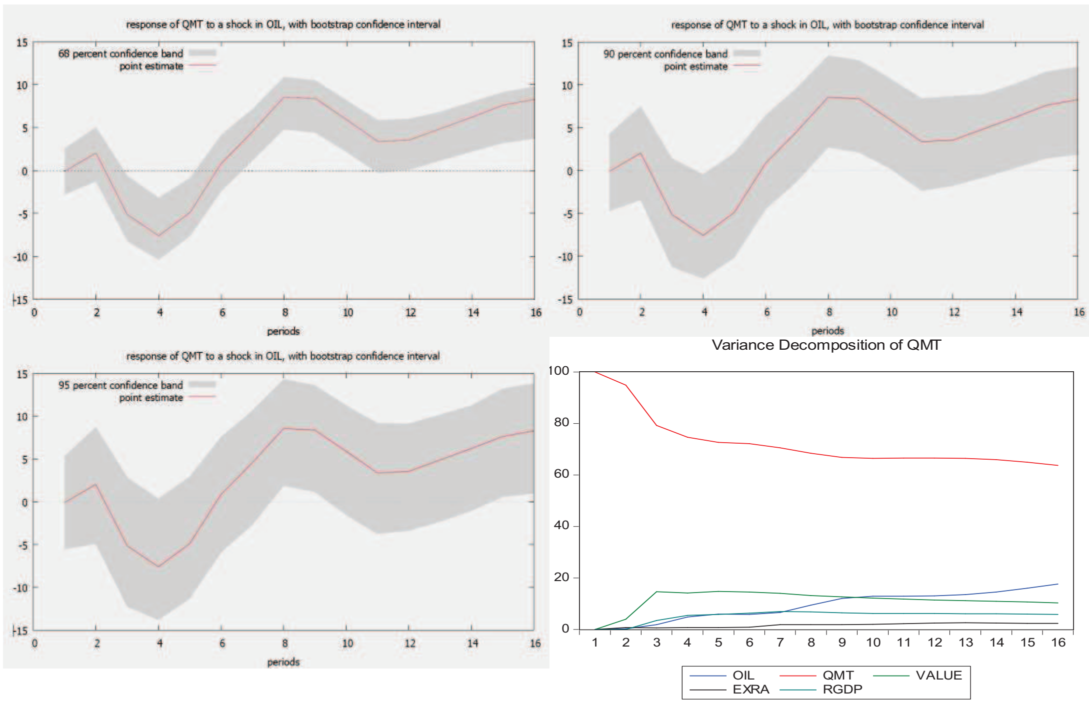

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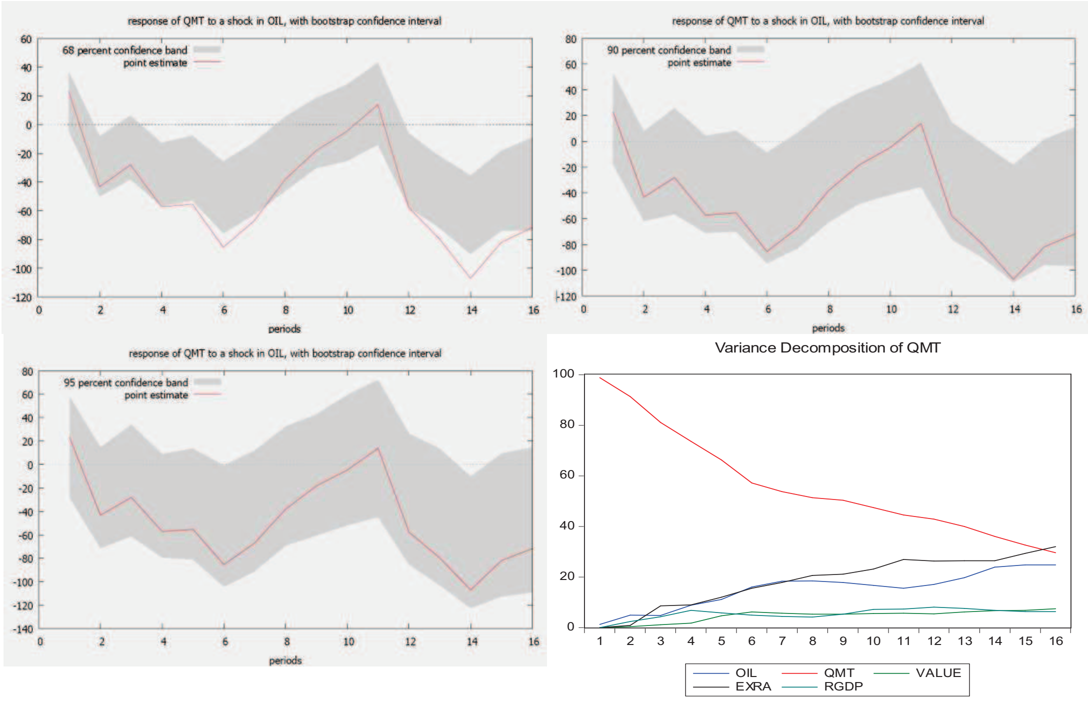
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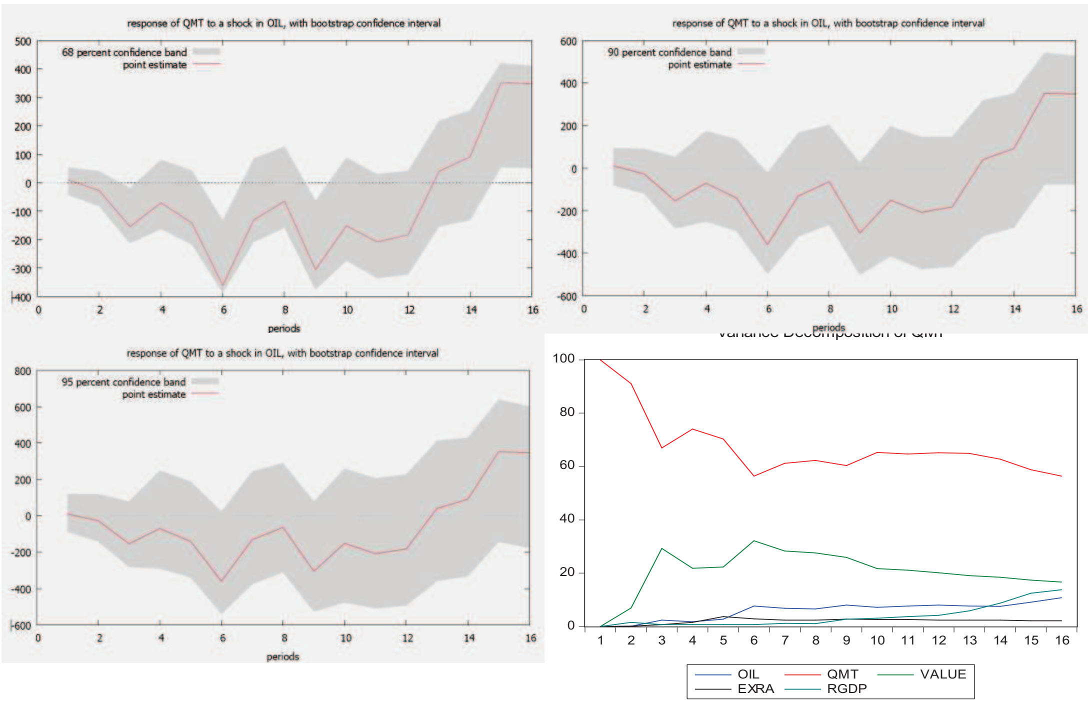
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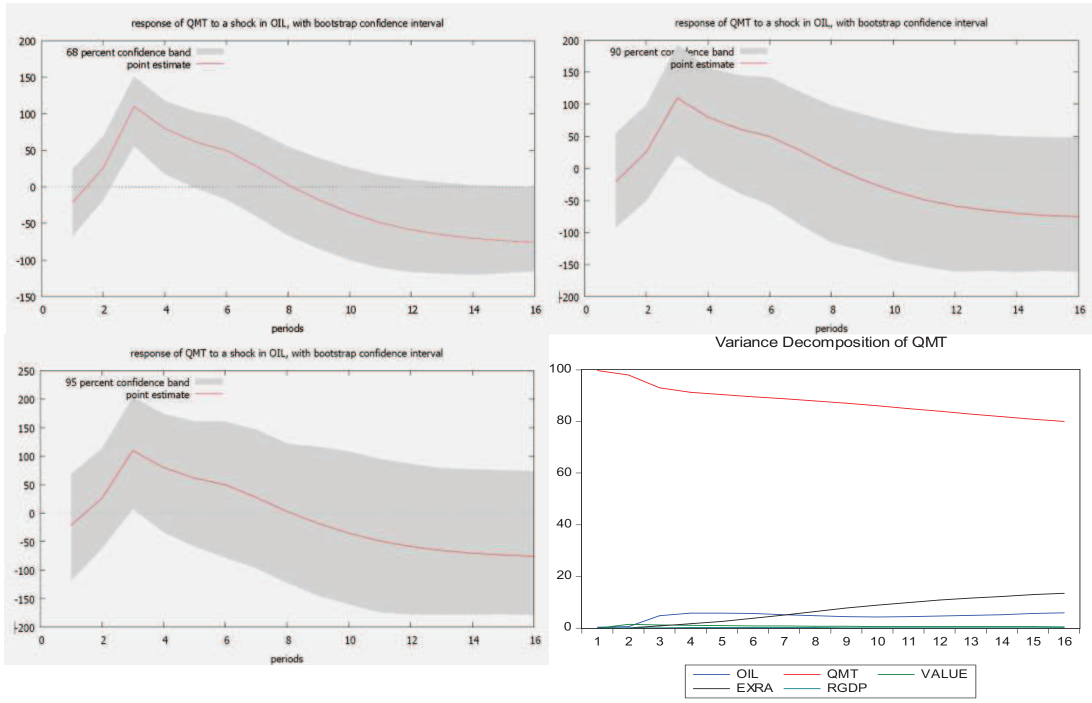
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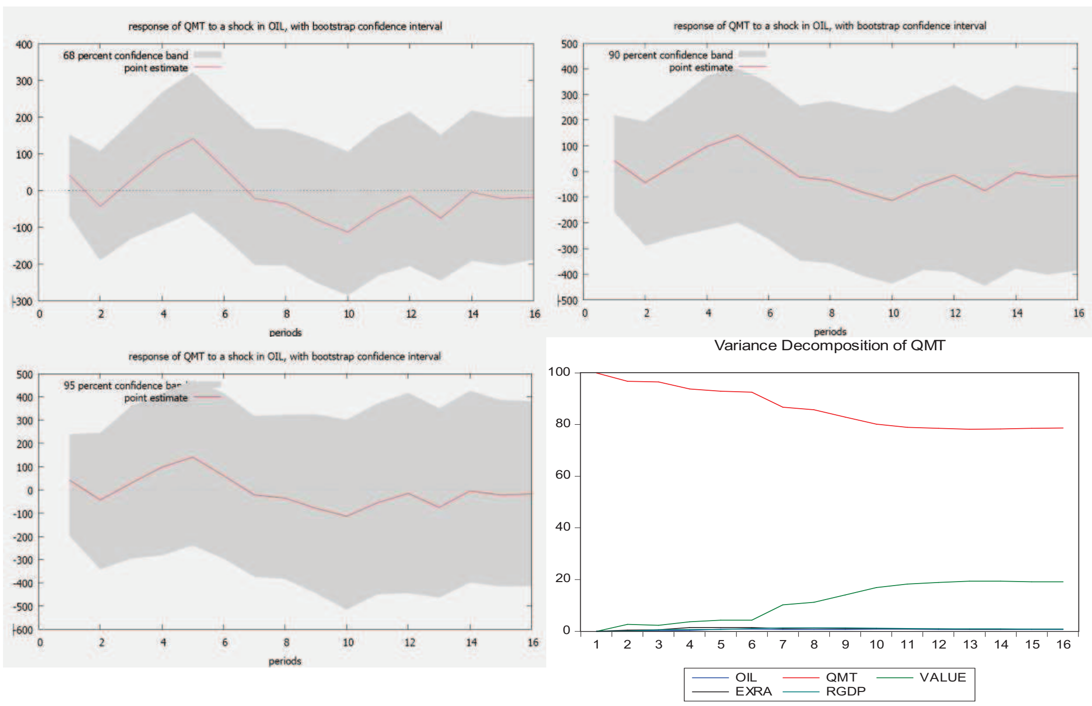
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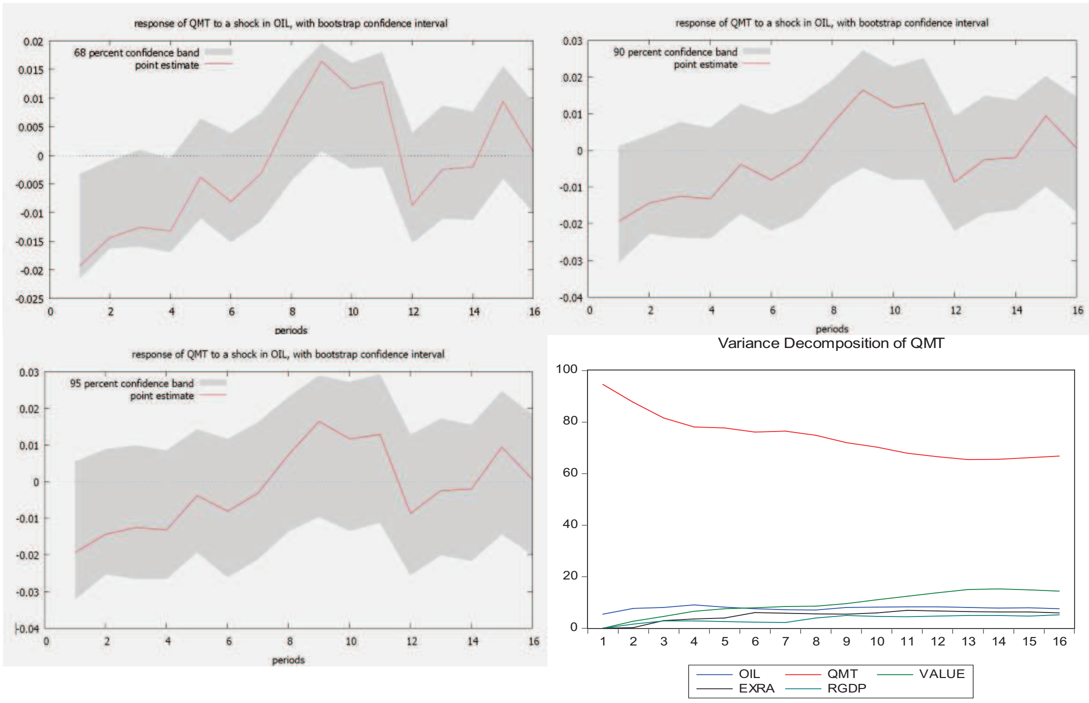
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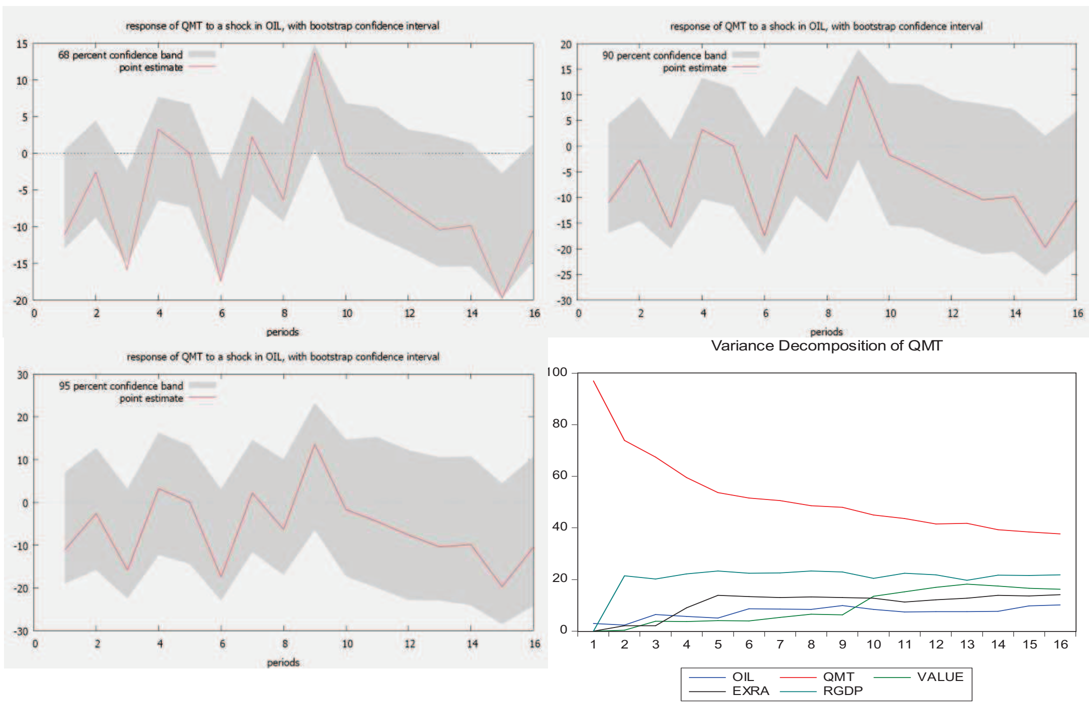
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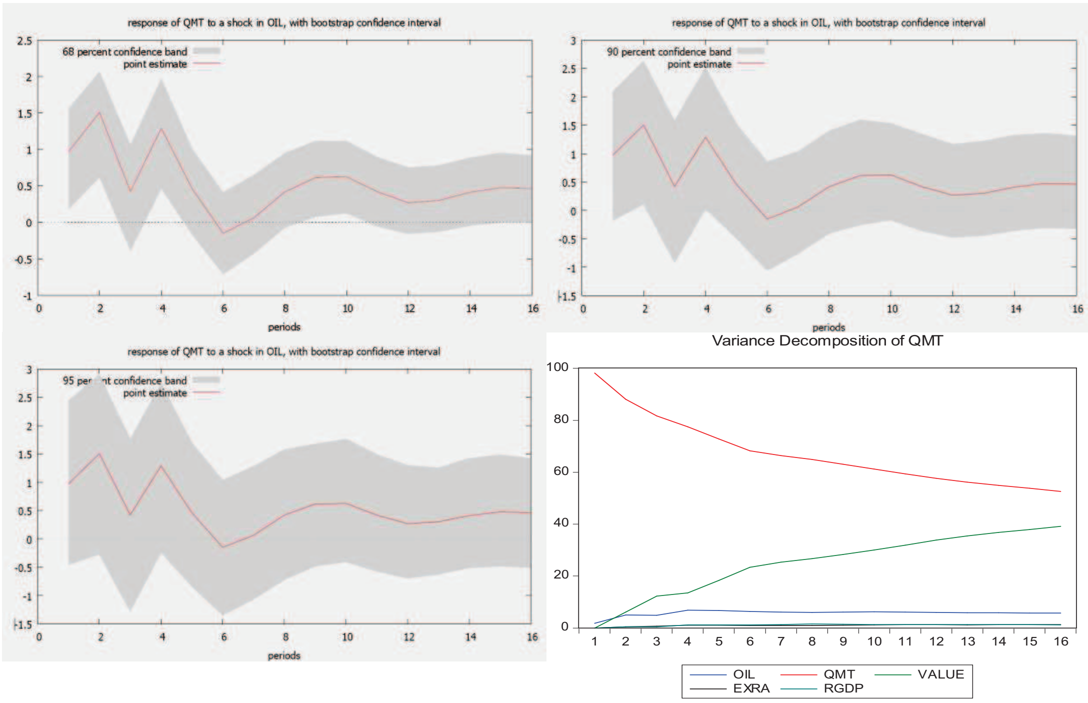
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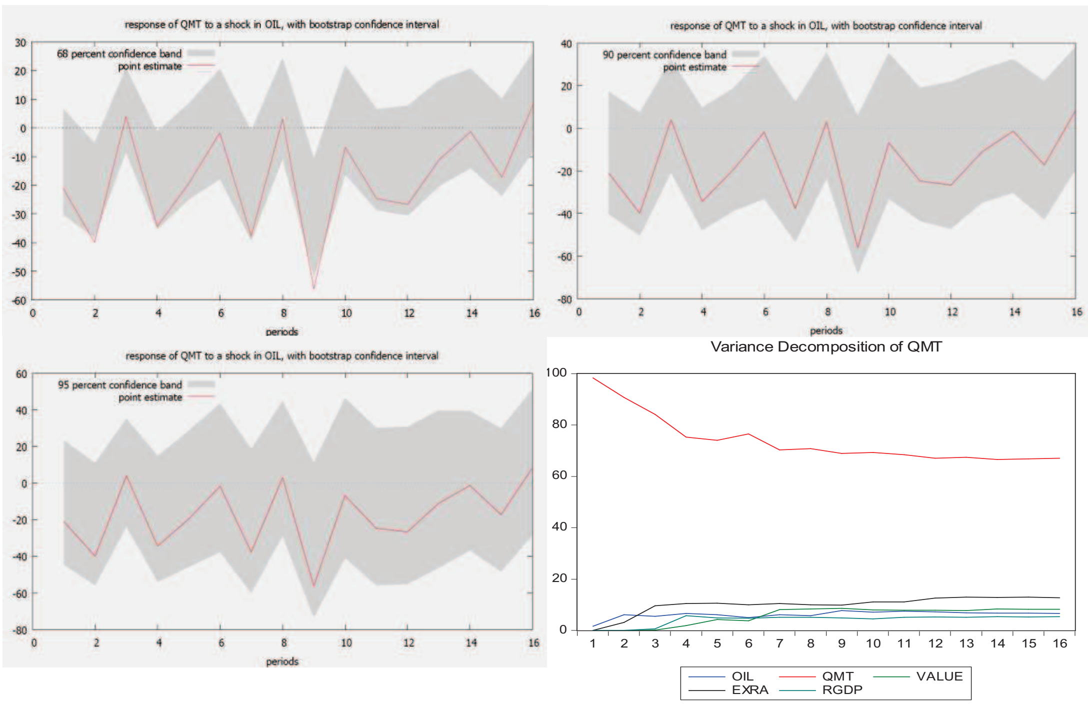
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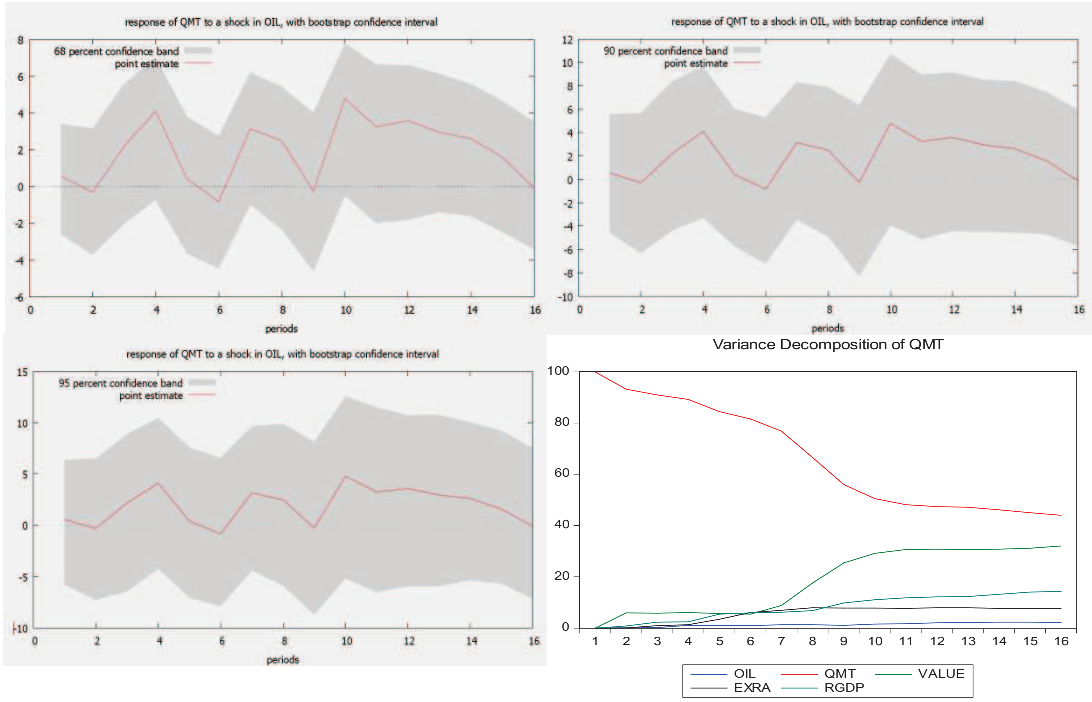
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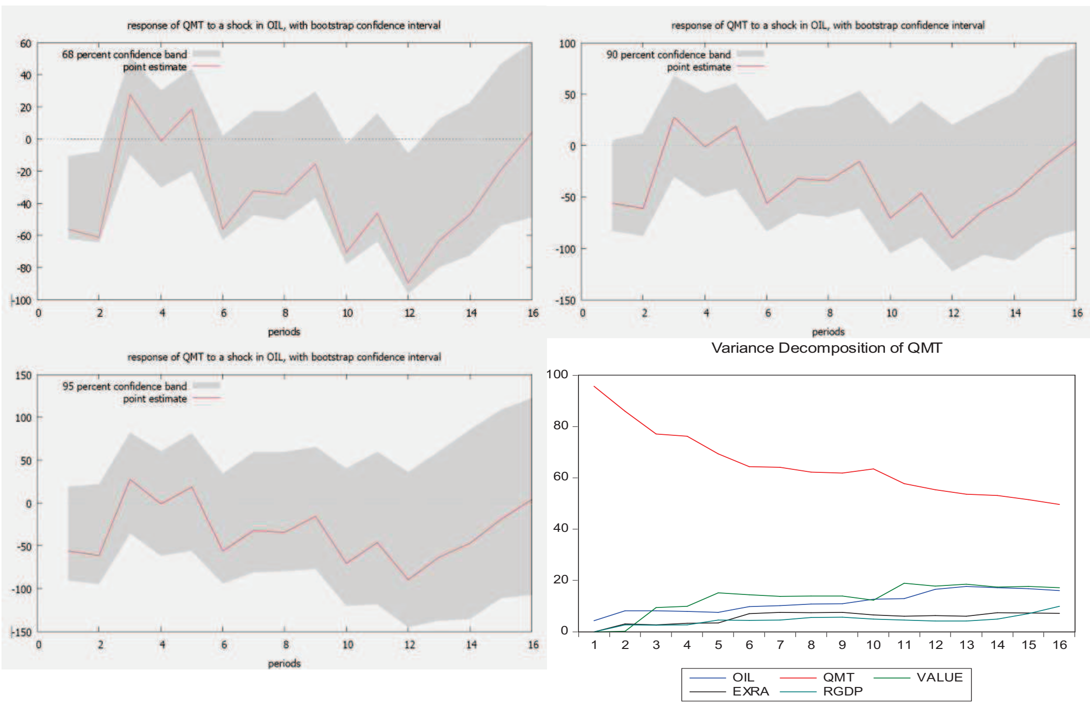
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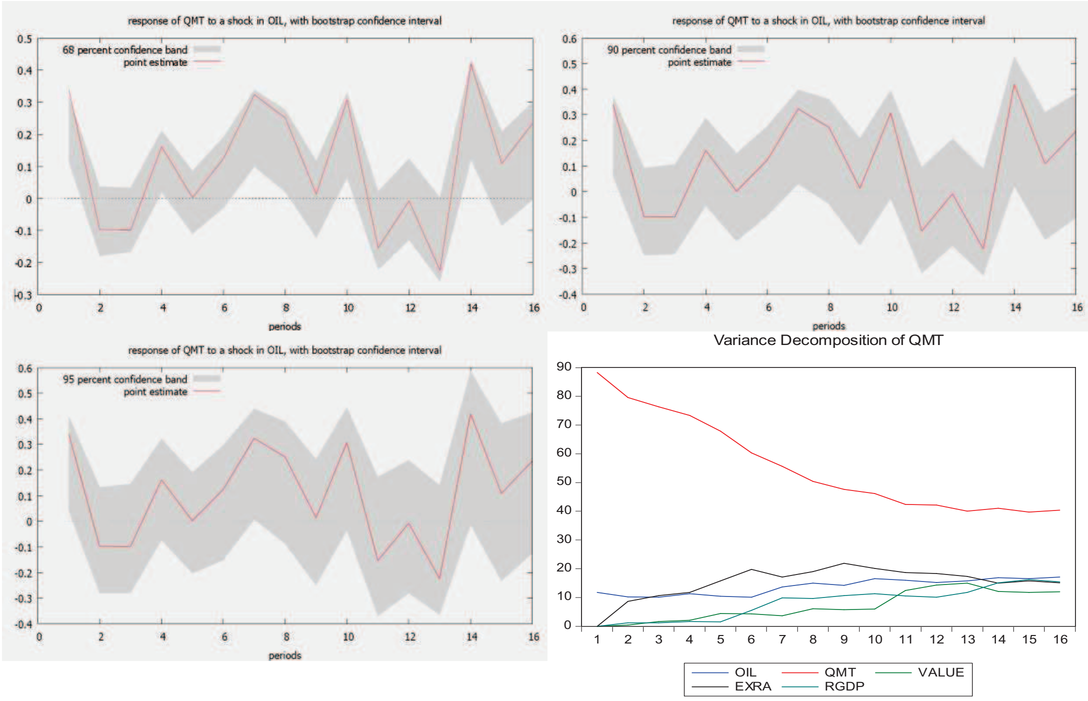
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68 percent confidence band
point estimate
periods
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90 percent confidence band
point estimate
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95 percent confidence band
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periods
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QMT
VALUE
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RGDP

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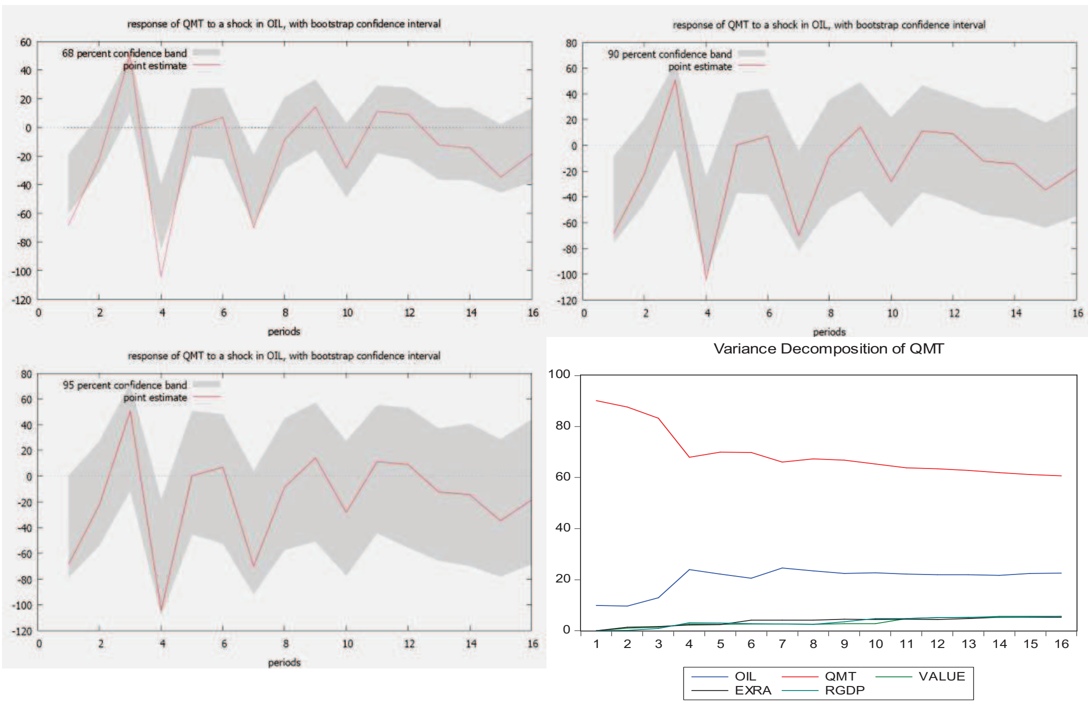
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Variance Decomposition of QMT
OIL
QMT
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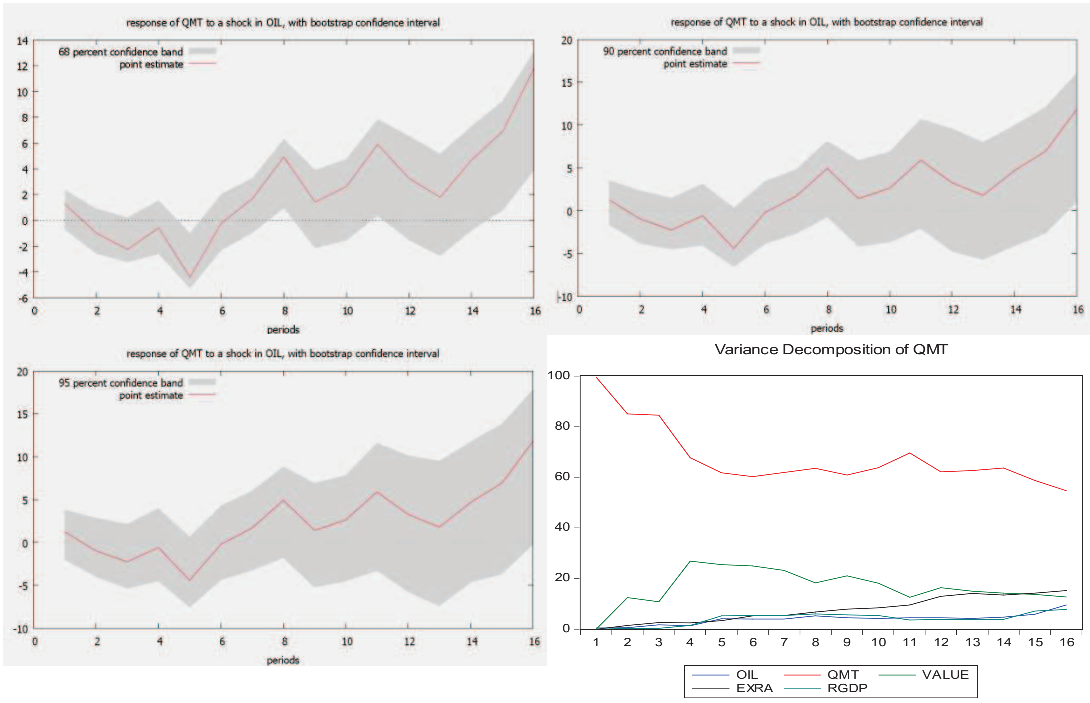
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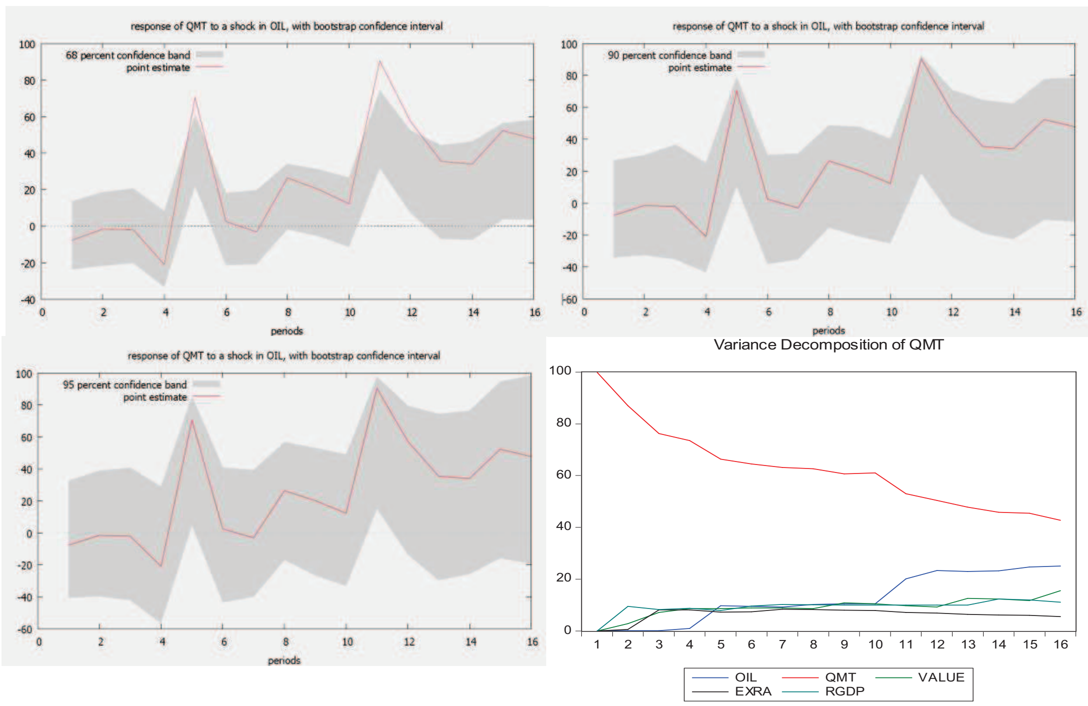
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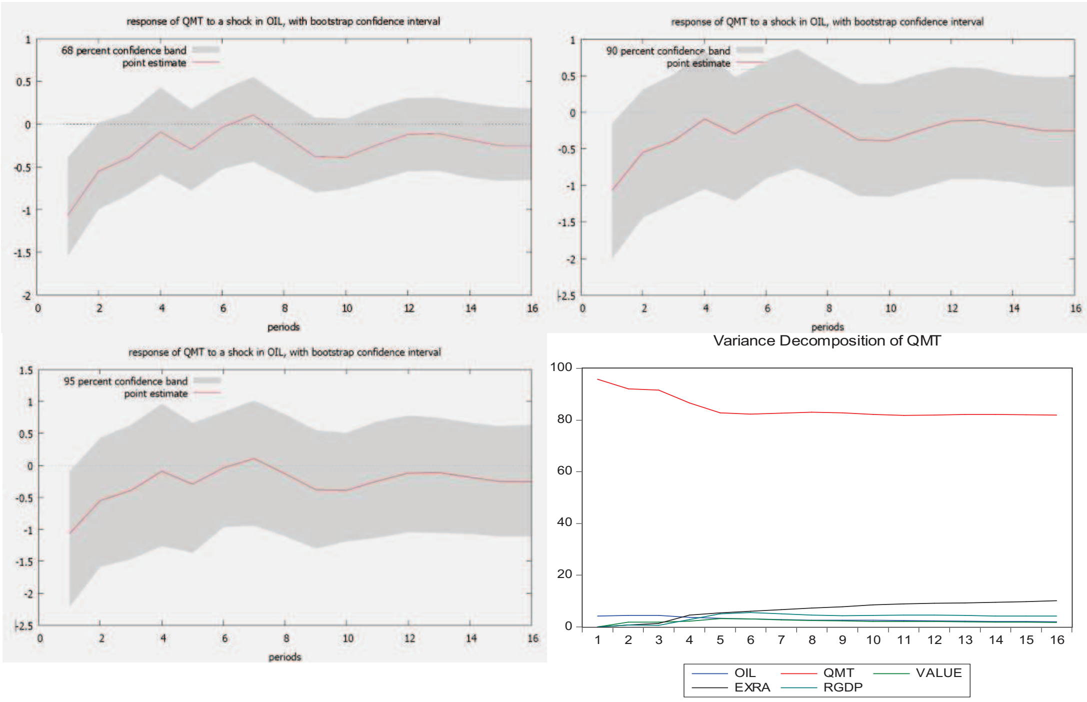
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OIL
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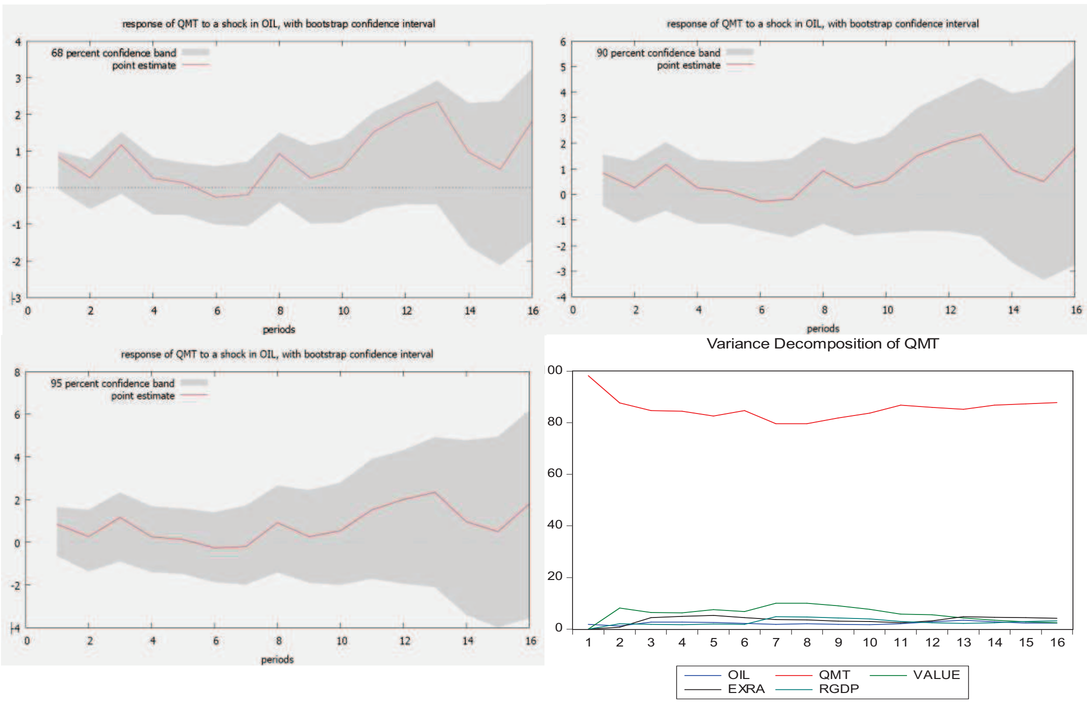
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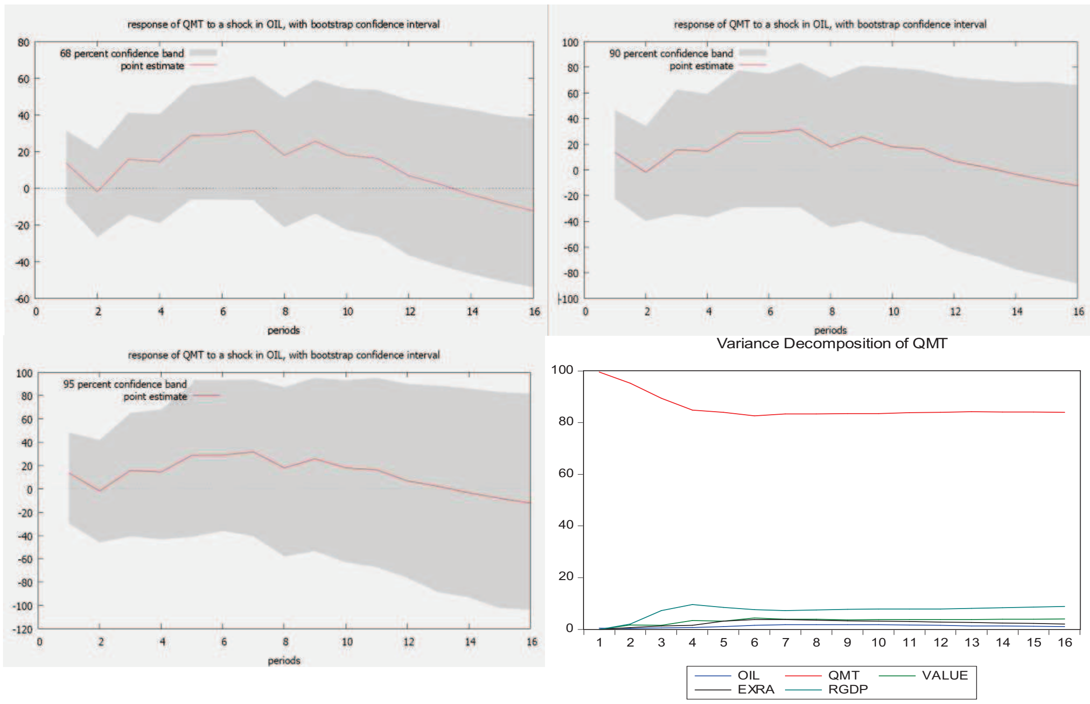
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OIL
QMT
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RGDP

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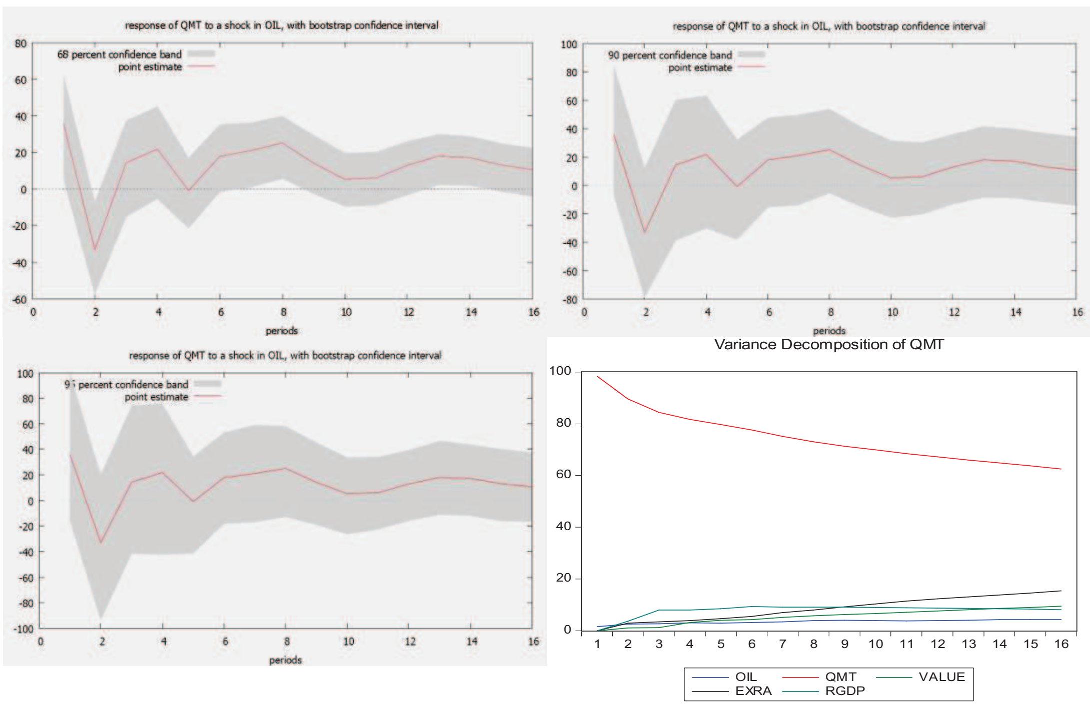
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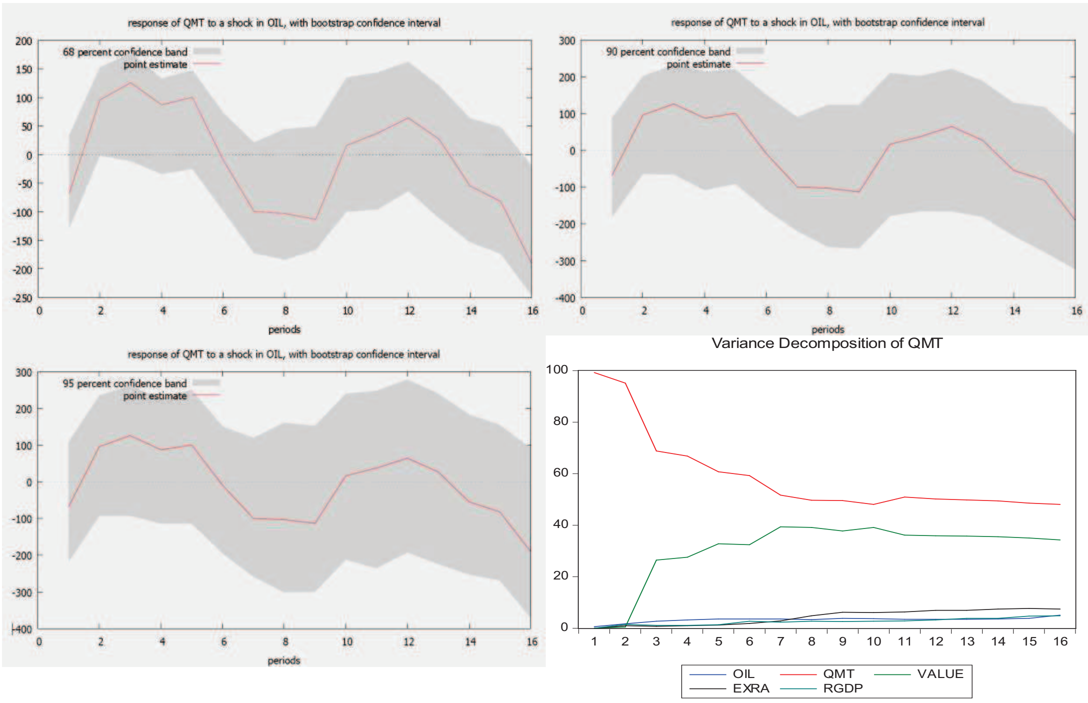
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RGDP

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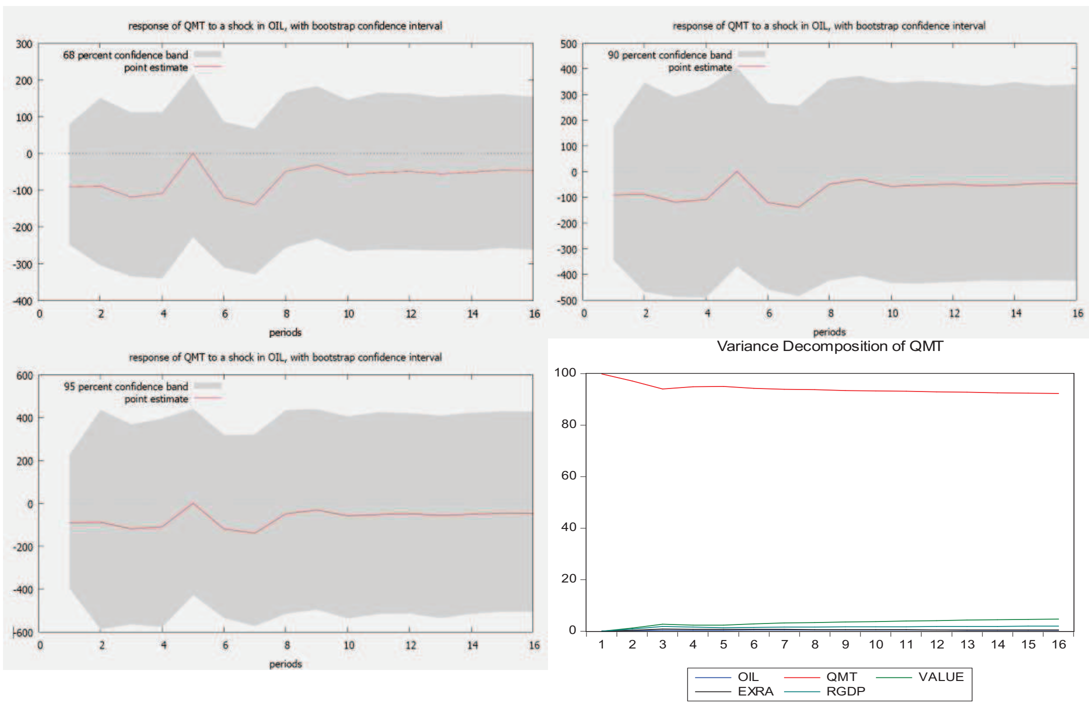
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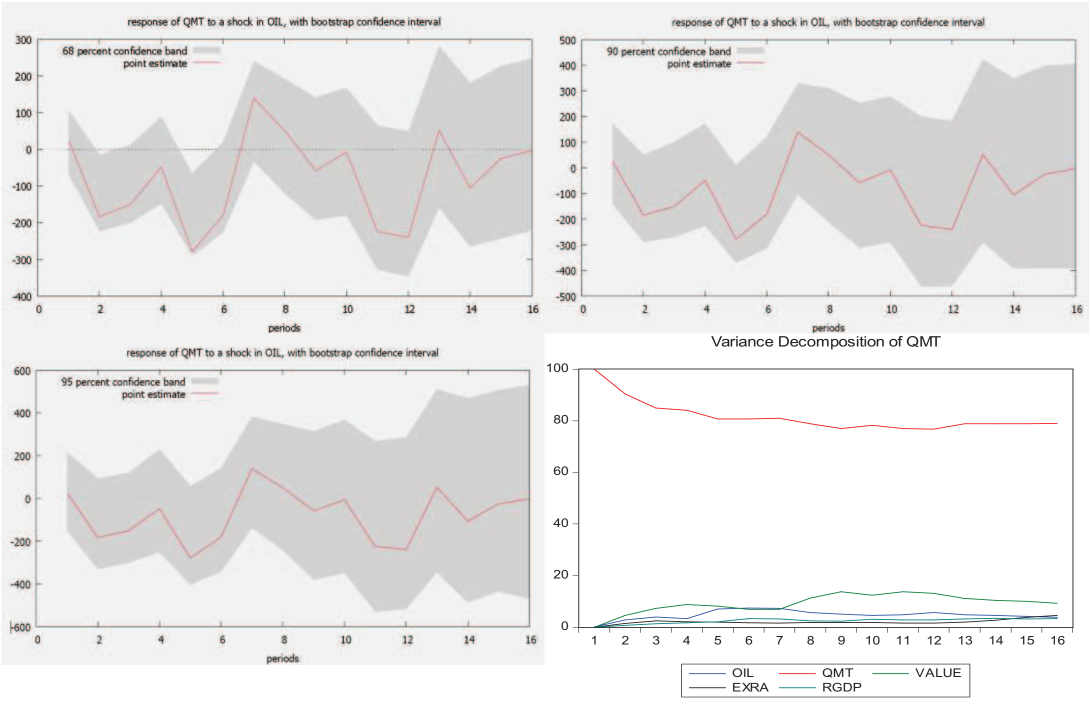
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OIL
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RGDP

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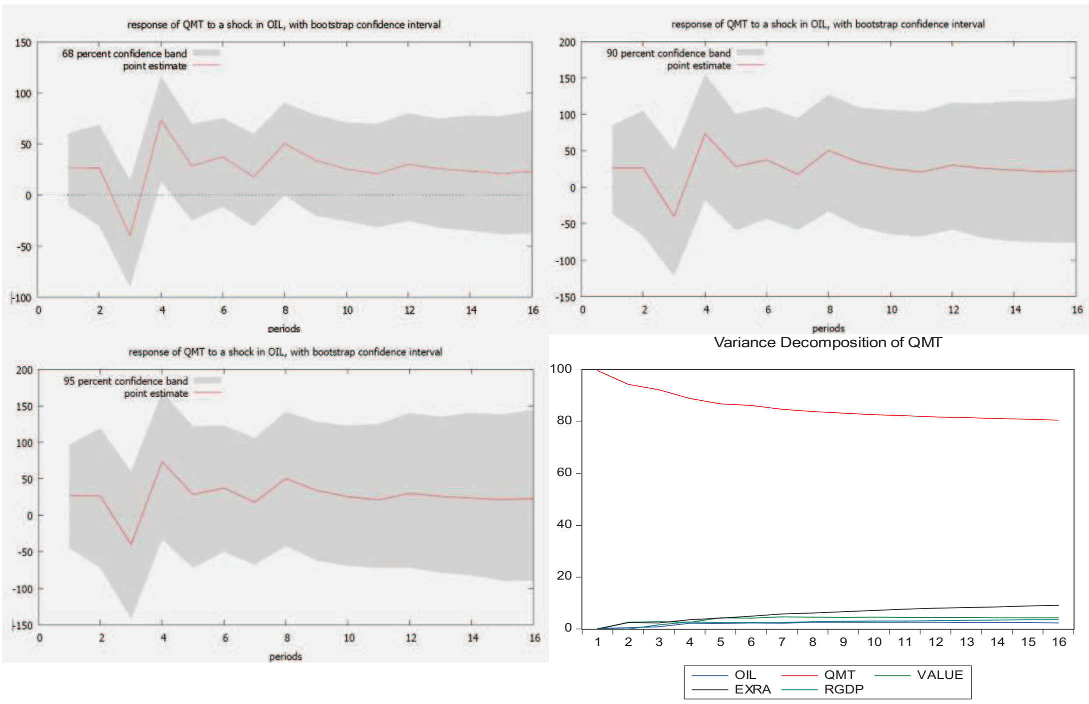
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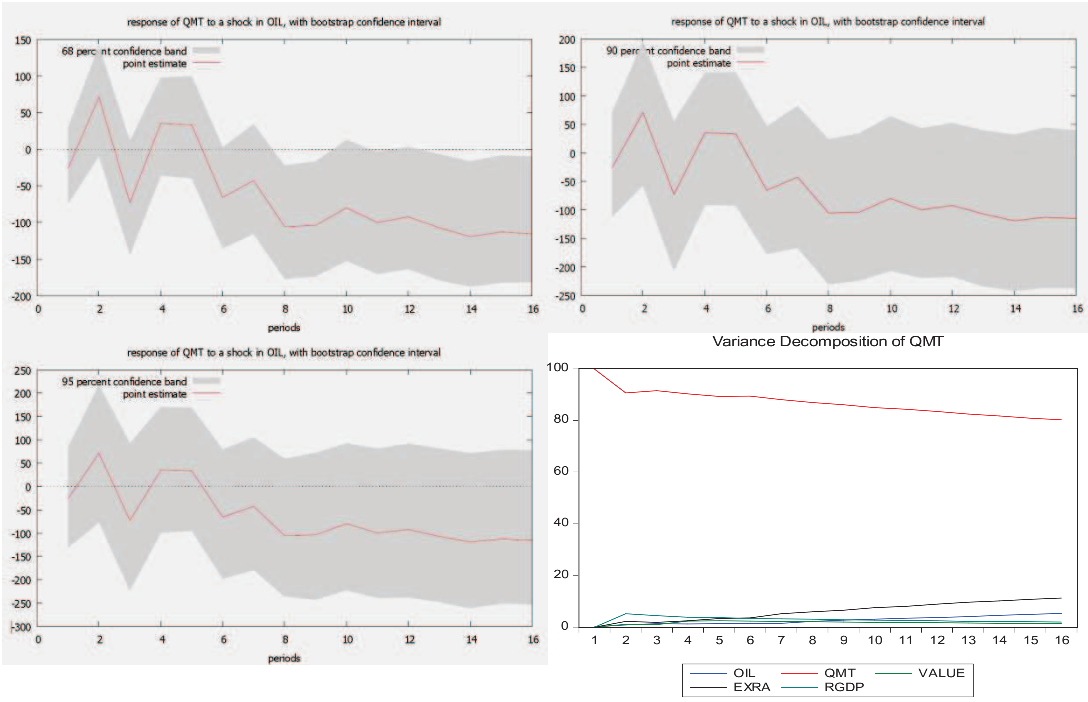
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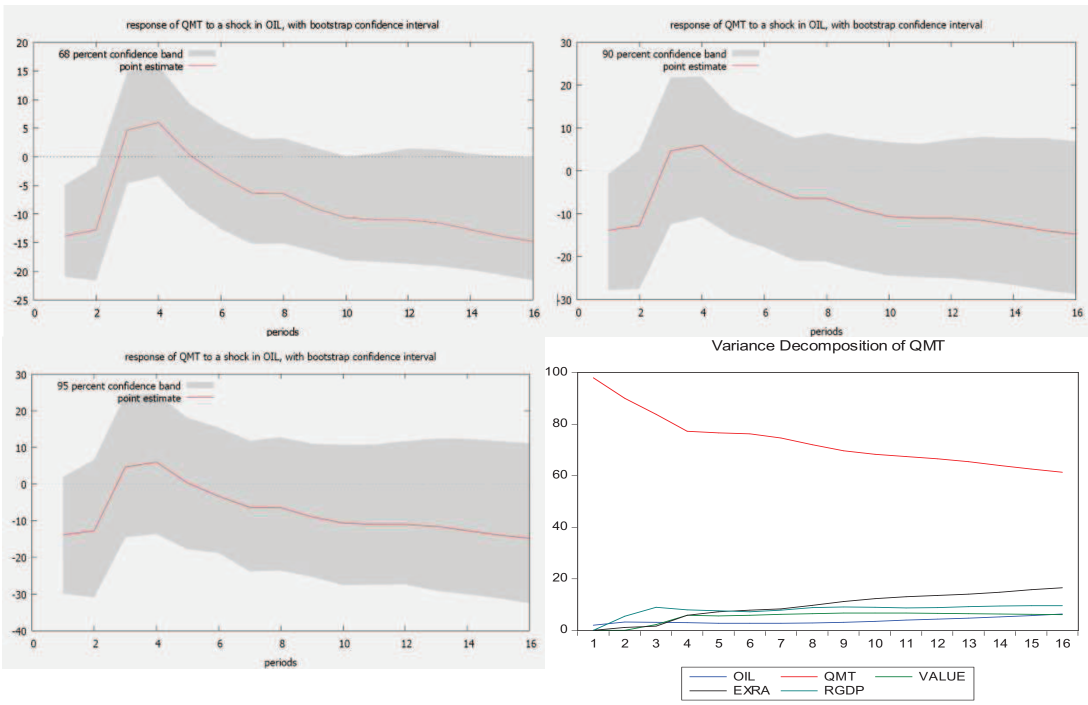
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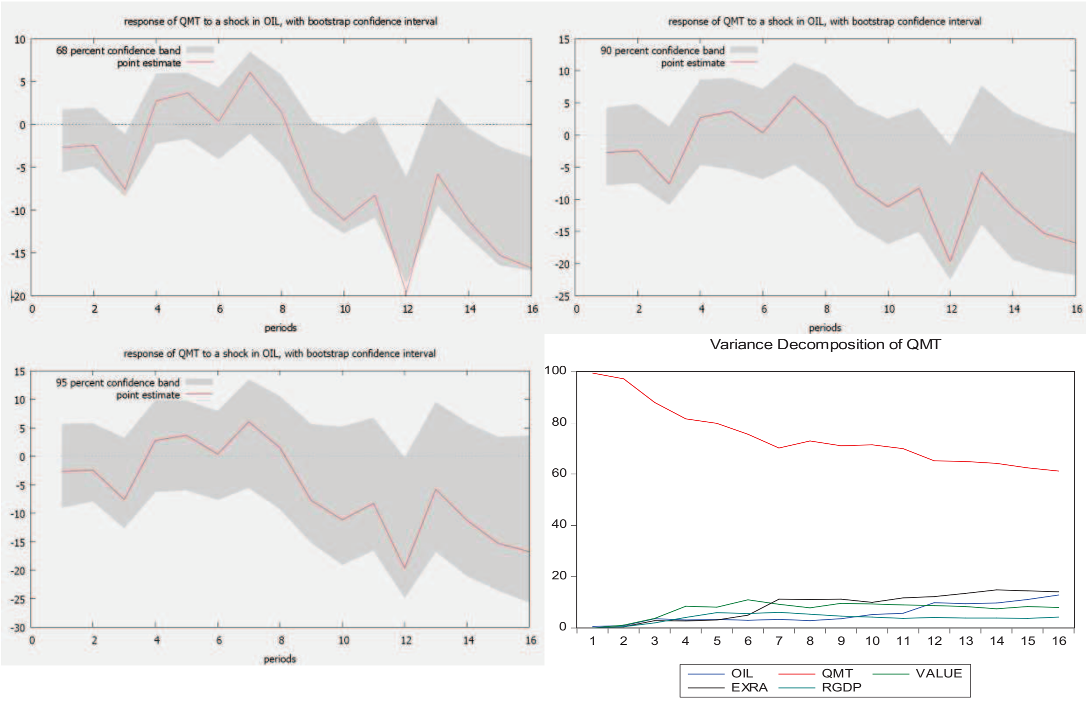
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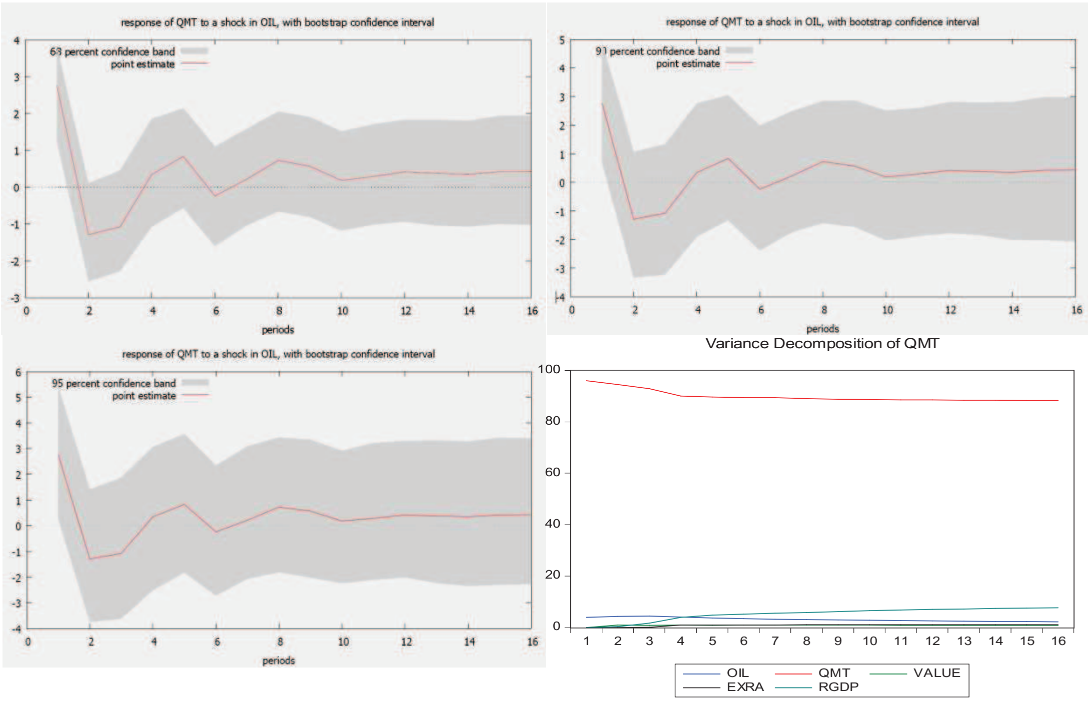
RGDP

4.2.8 Oceania (Australia)

1A



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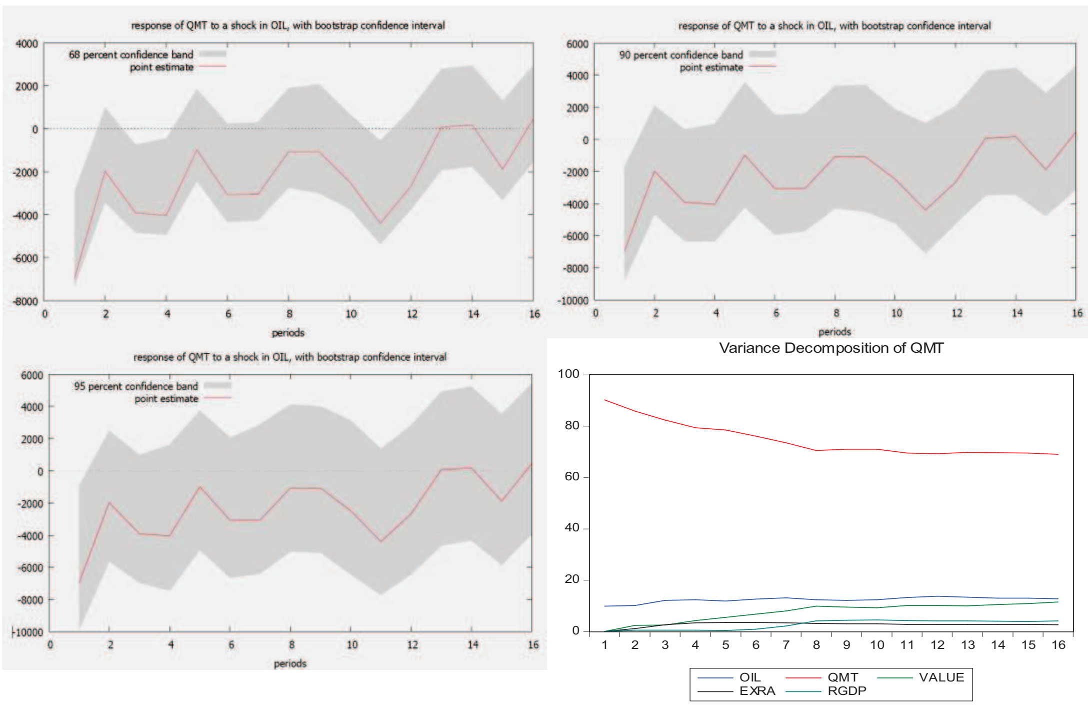

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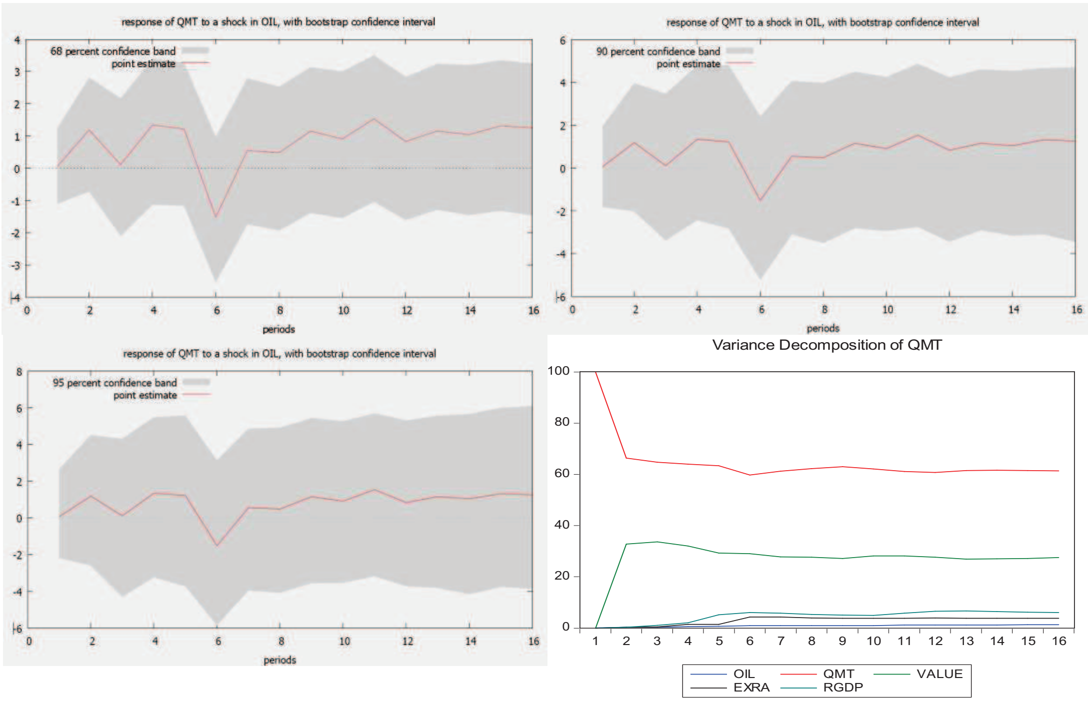
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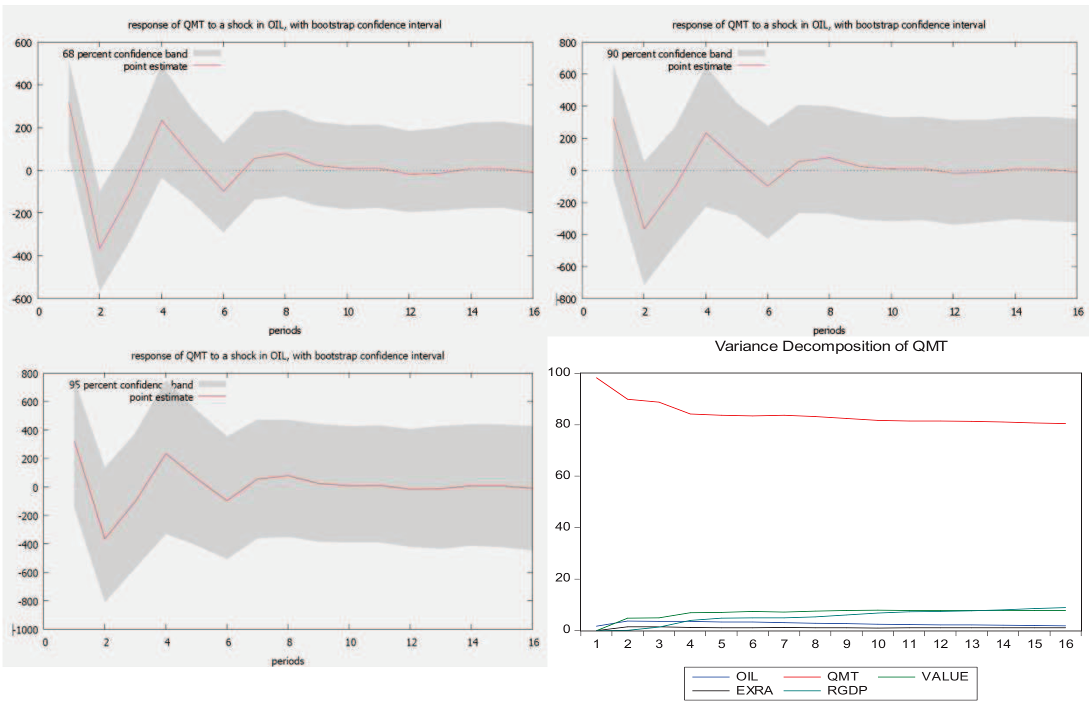
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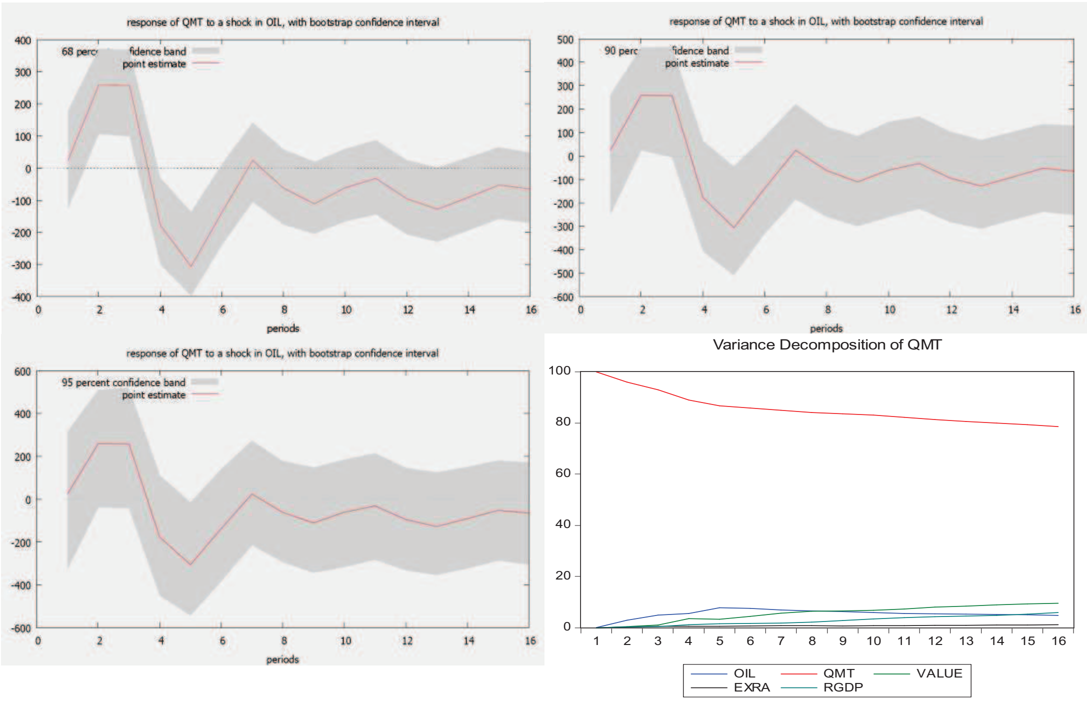
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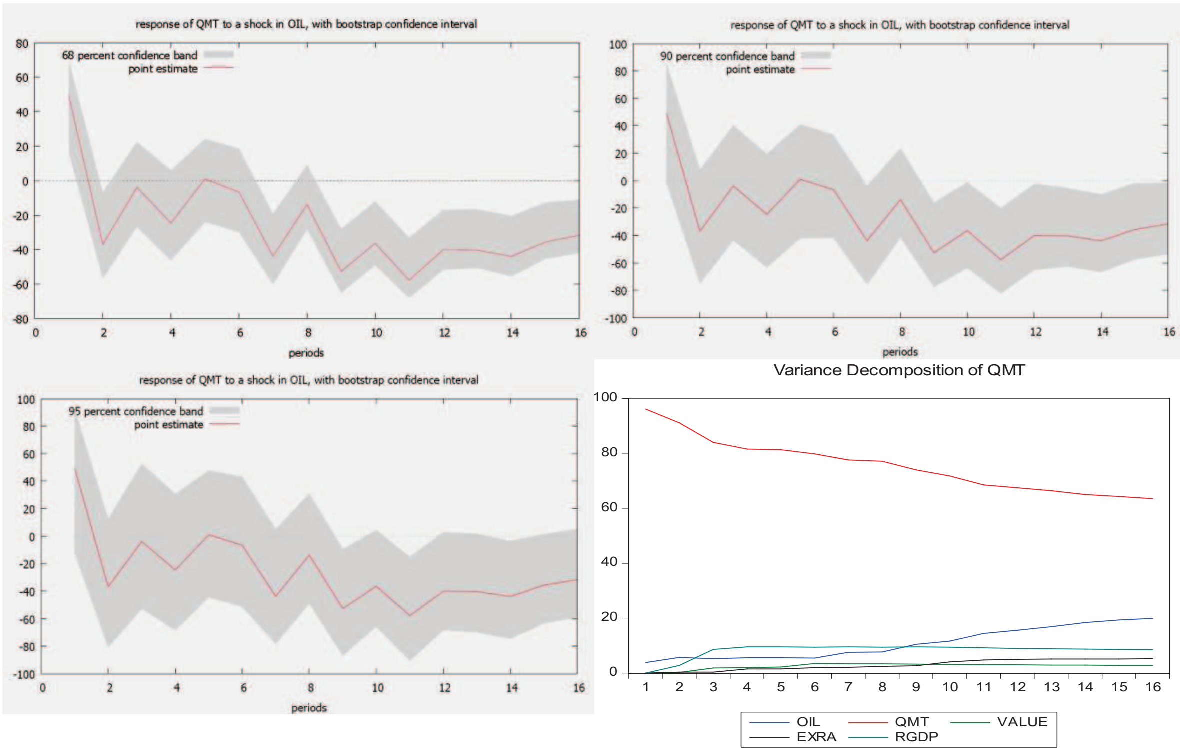
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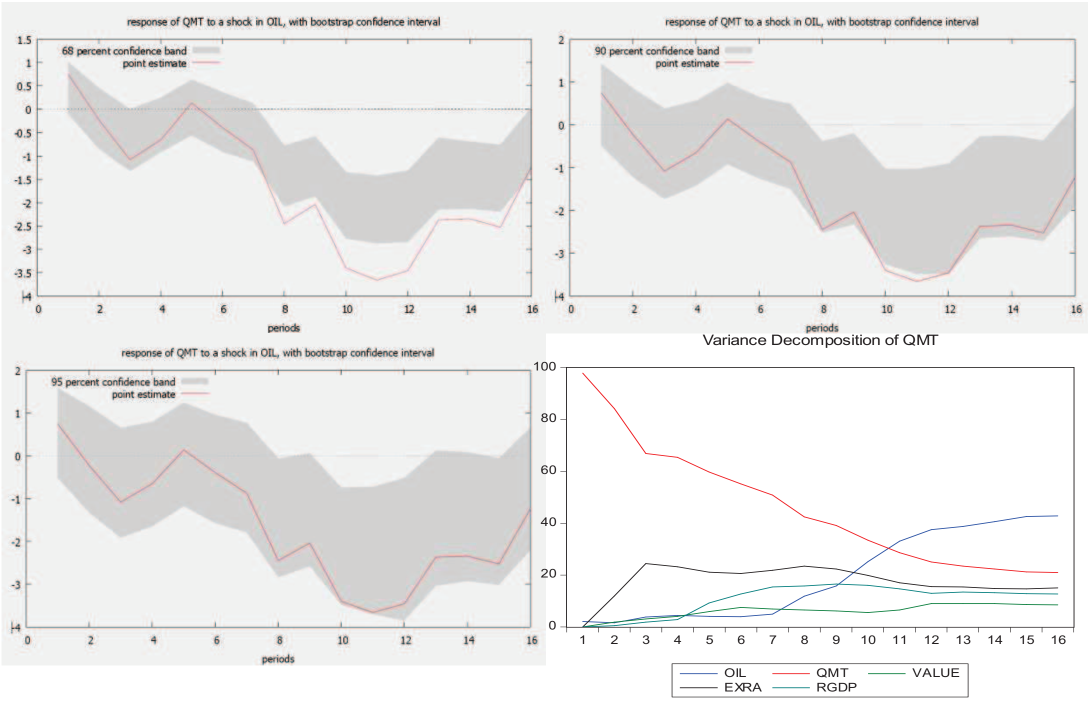
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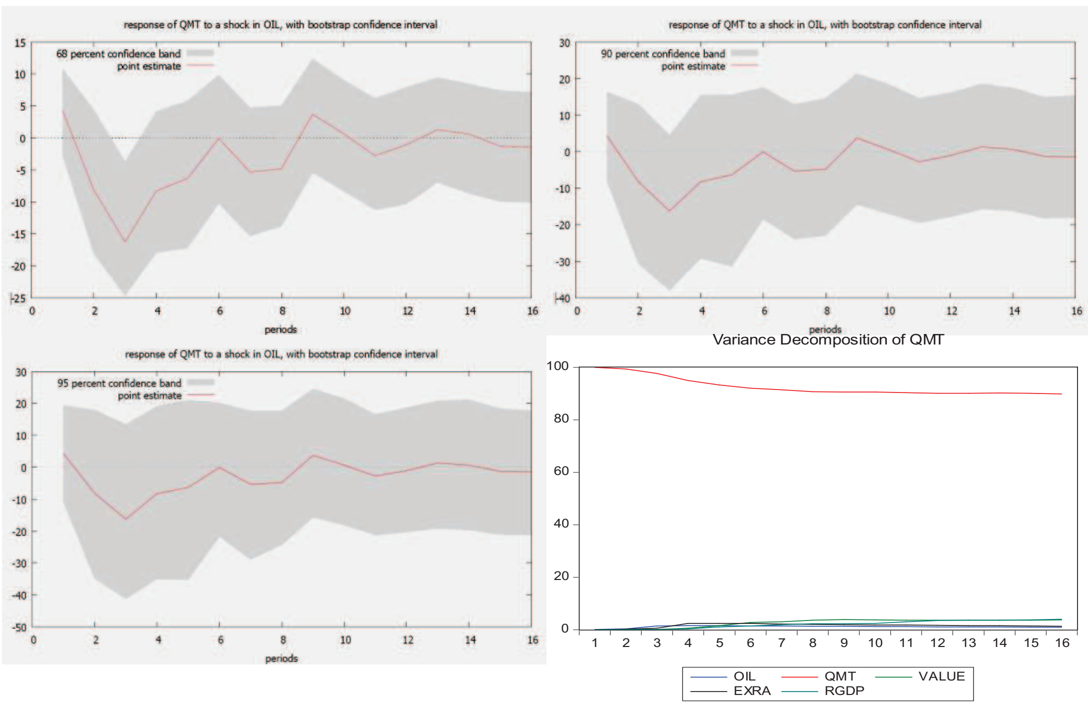
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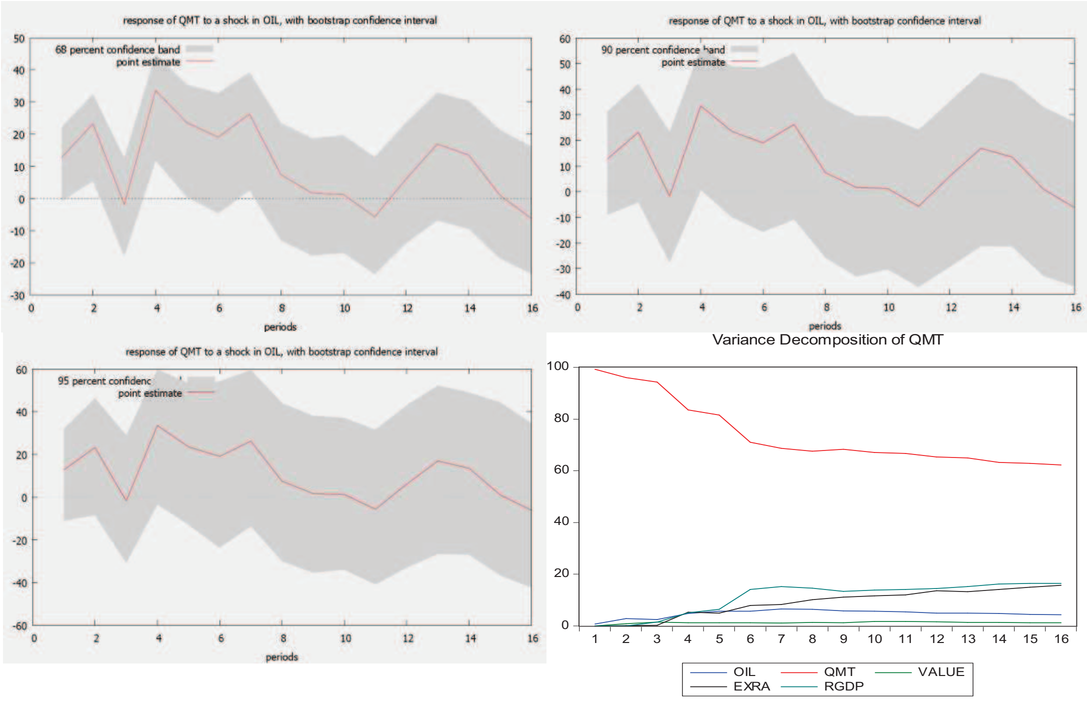
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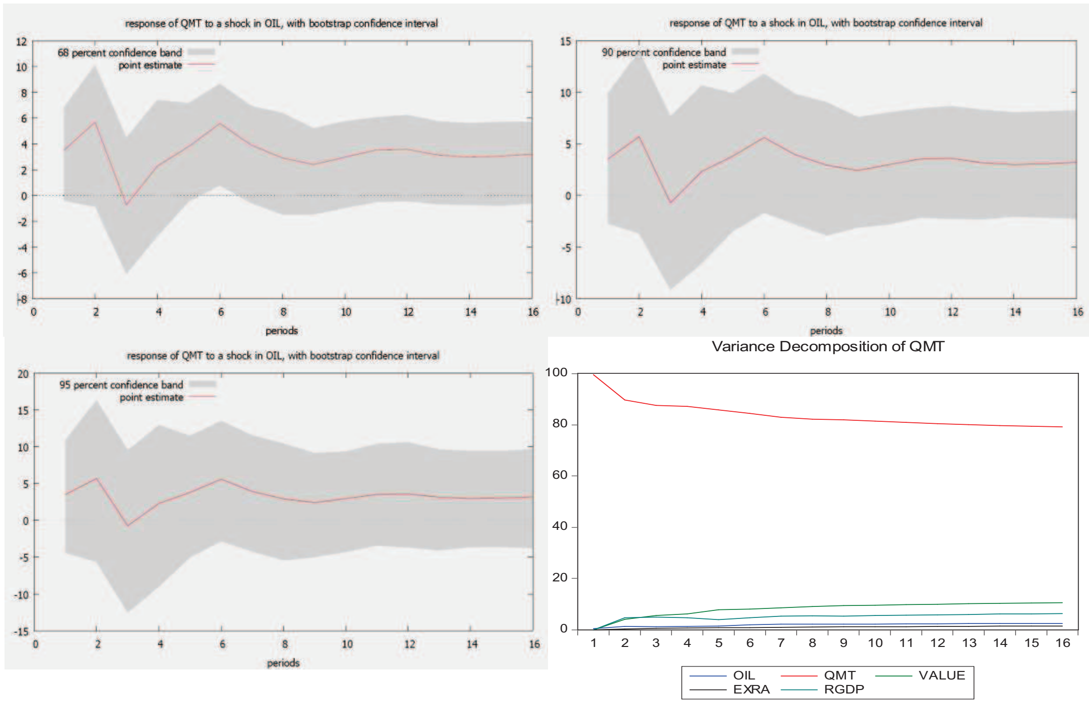
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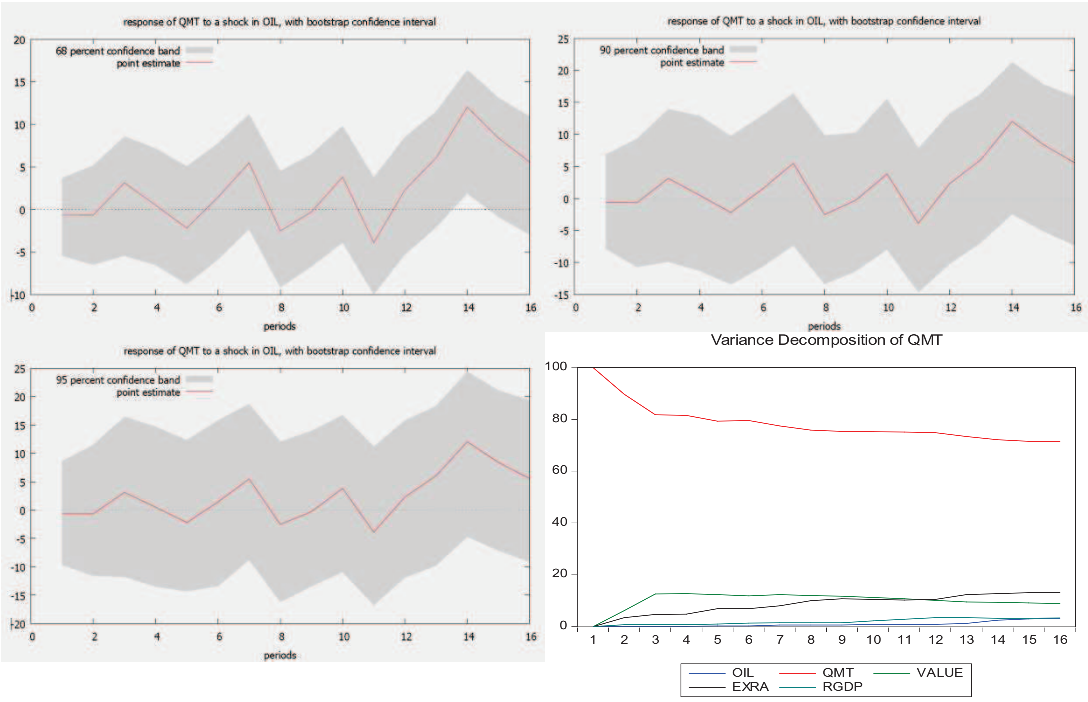
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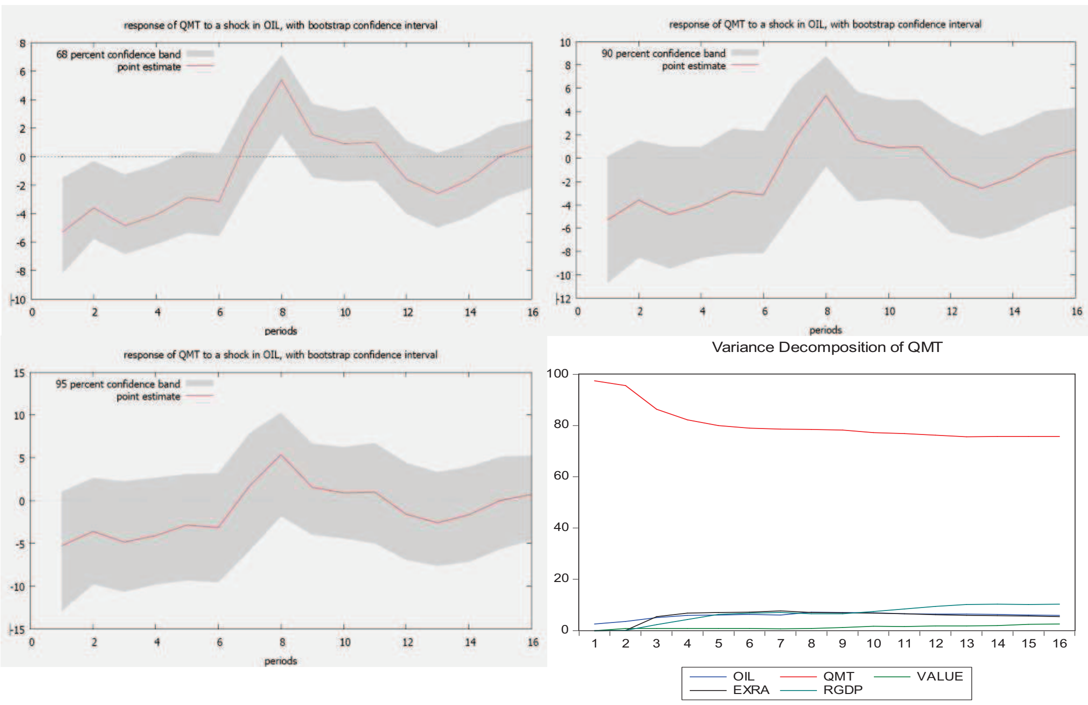
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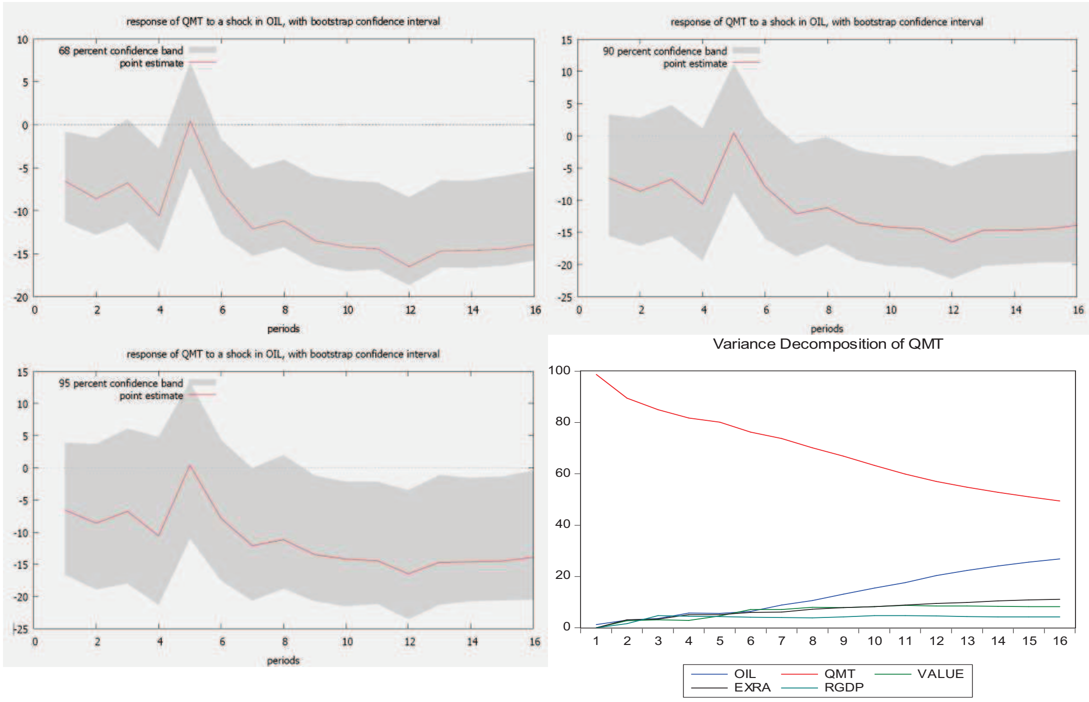
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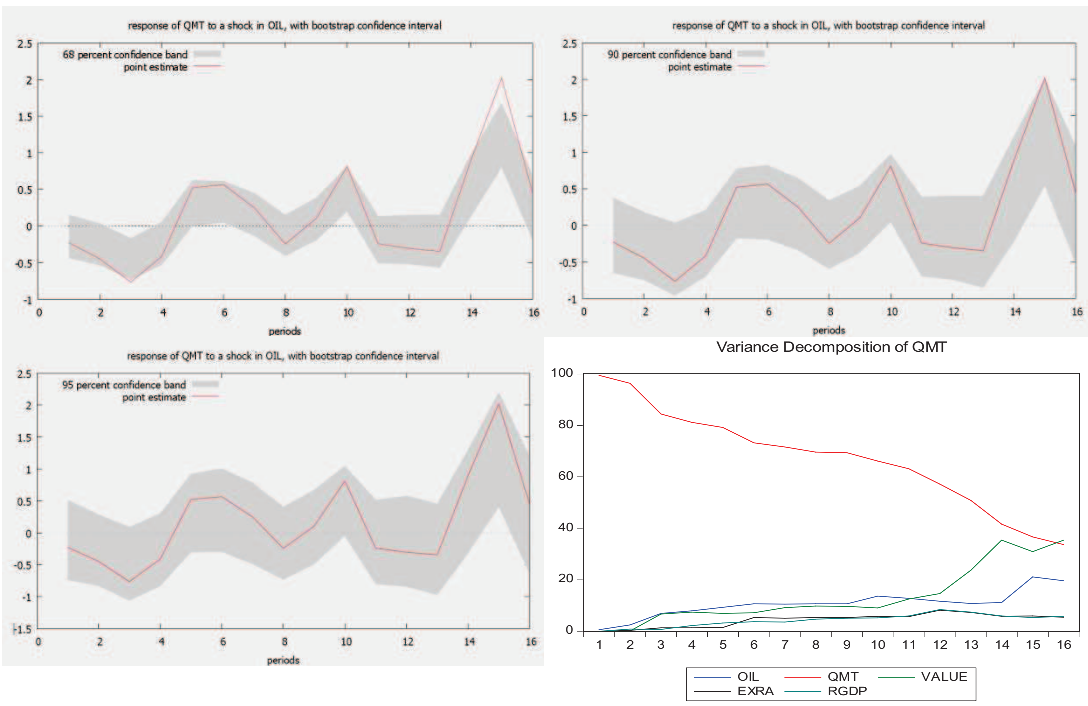
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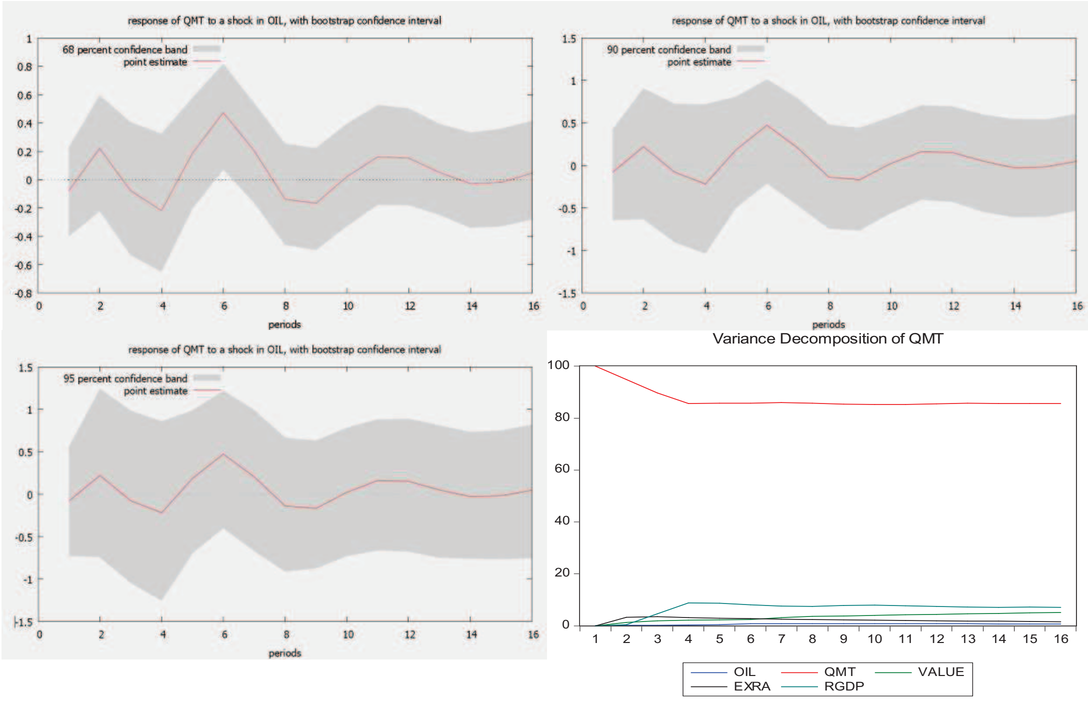
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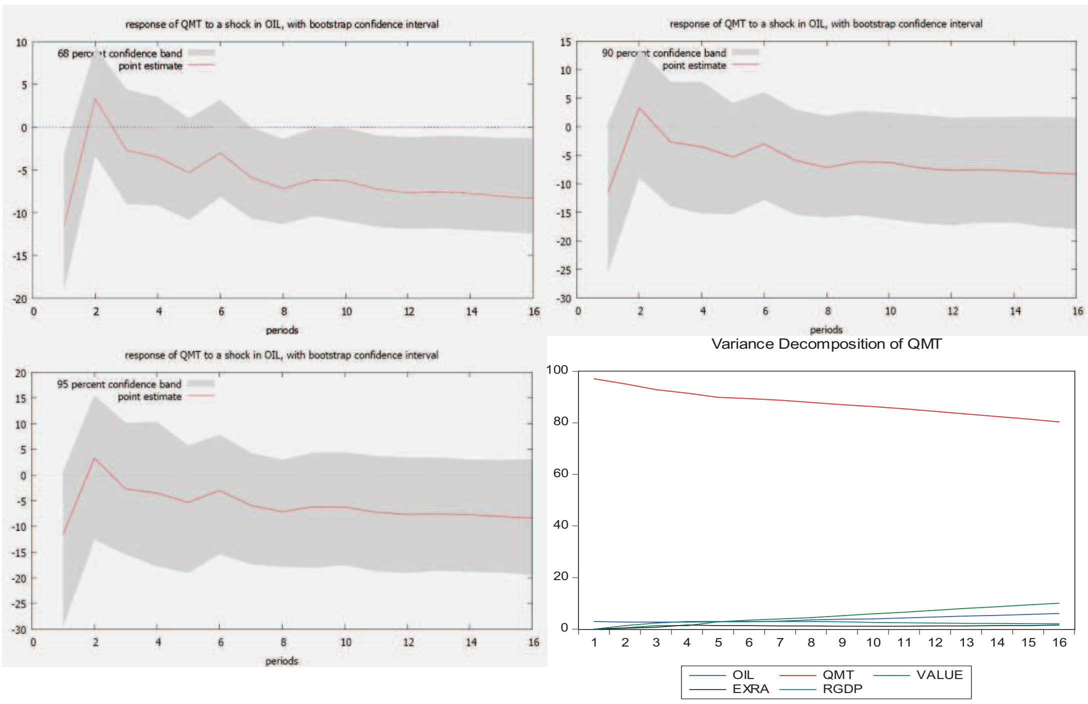
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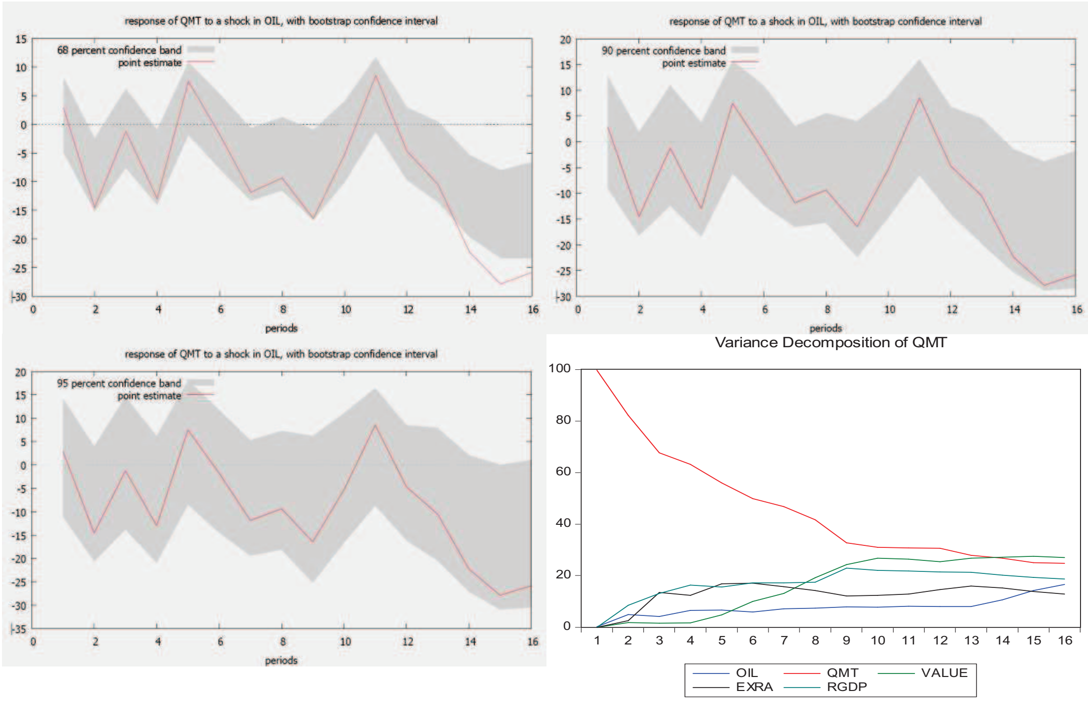
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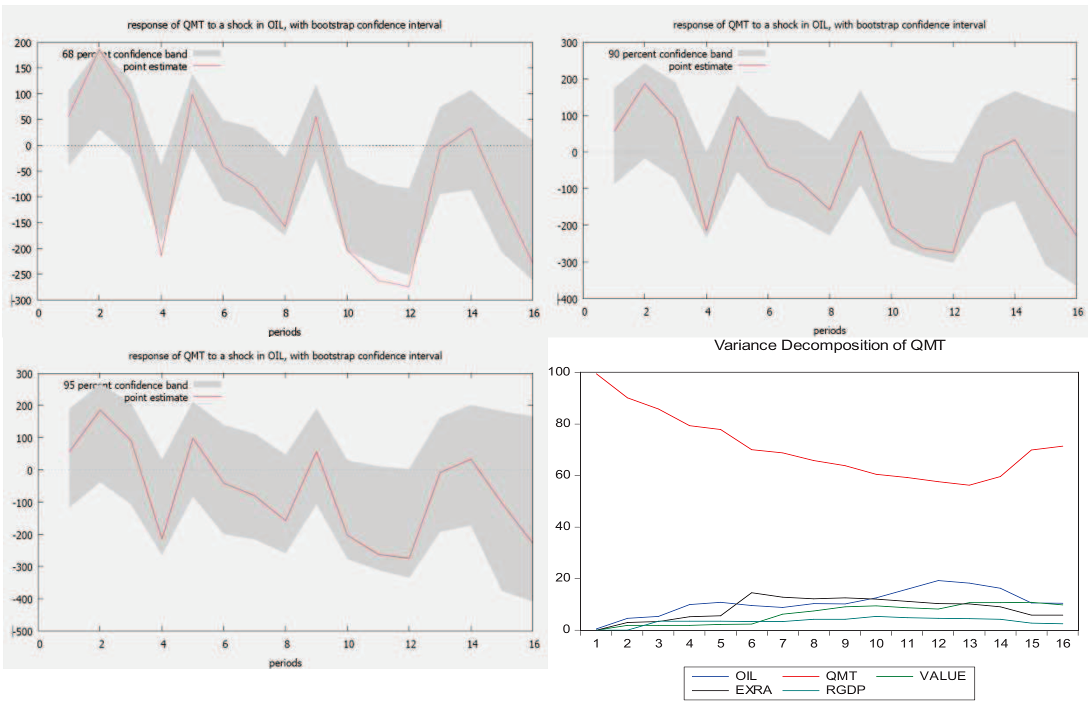
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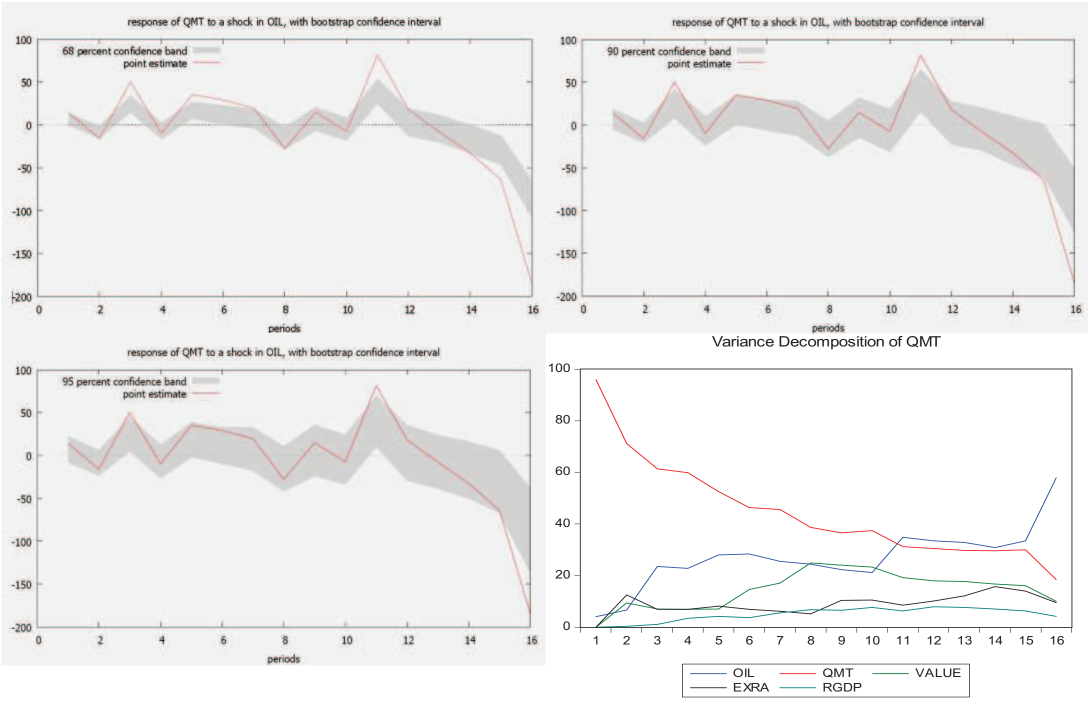
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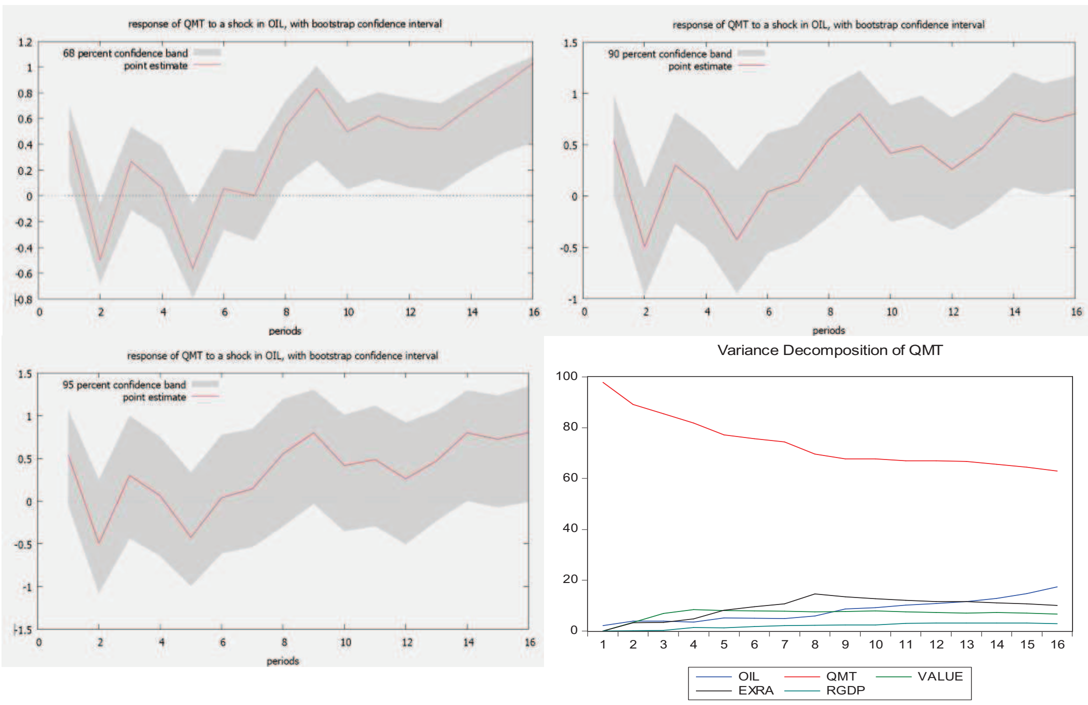
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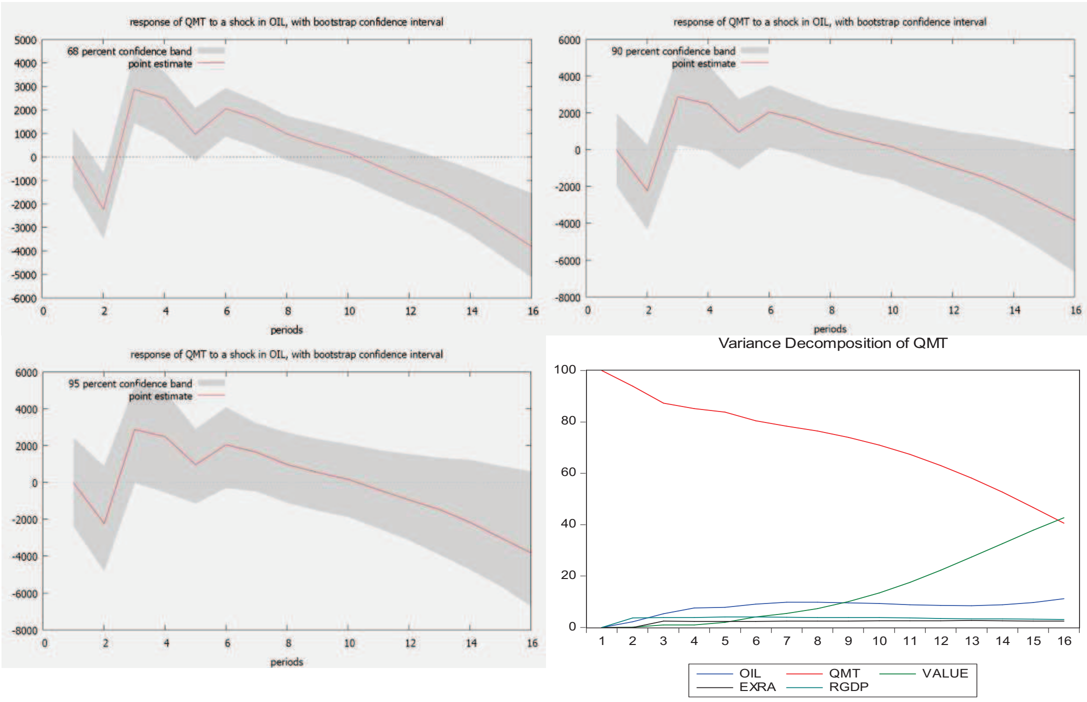
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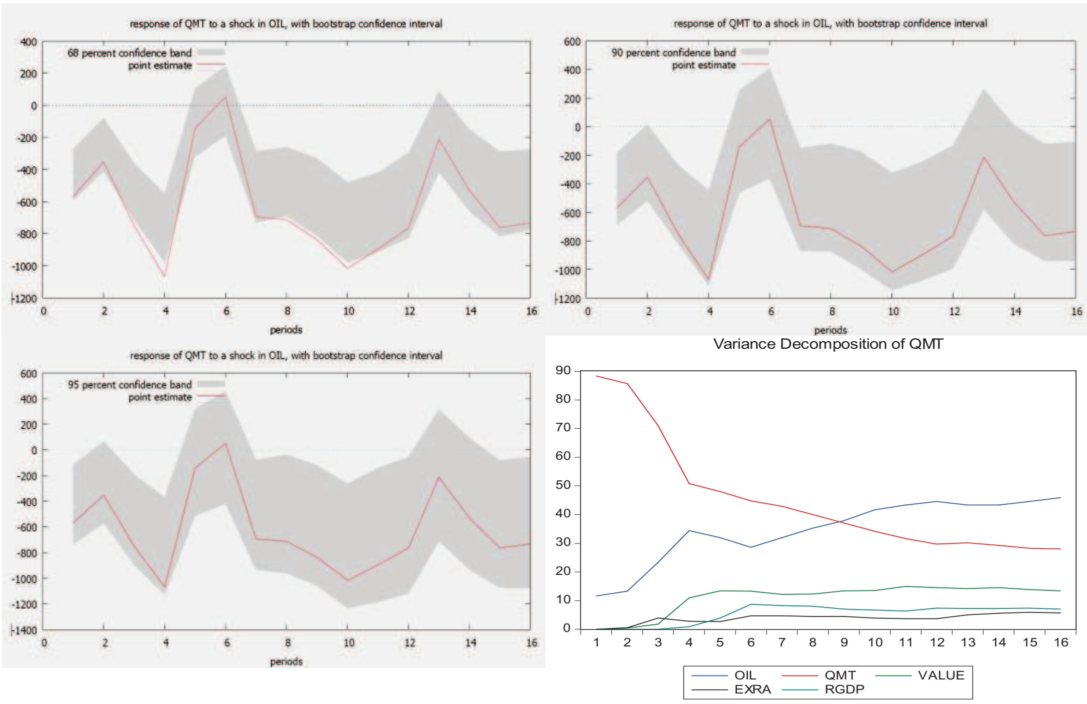
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QMT
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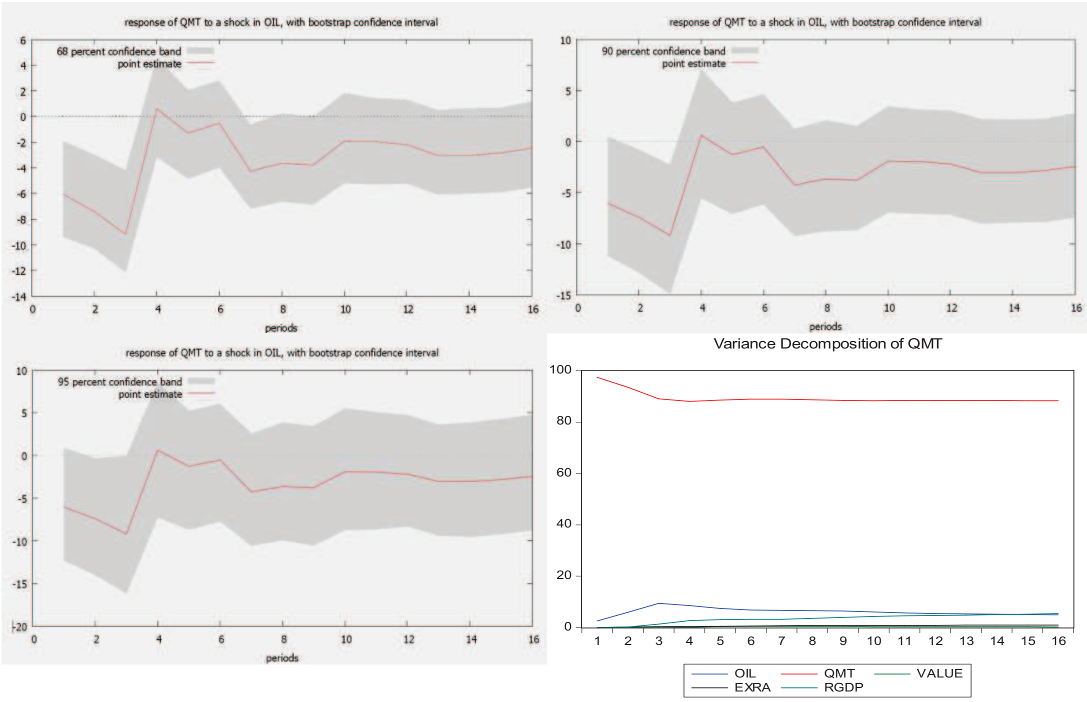
EXRA
RGDP

34


response of QMT to a shock in OIL, with bootstrap confidence interval
68 percent confidence band
point estimate
periods
response of QMT to a shock in OIL, with bootstrap confidence interval
90 percent confidence band
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response of QMT to a shock in OIL, with bootstrap confidence interval
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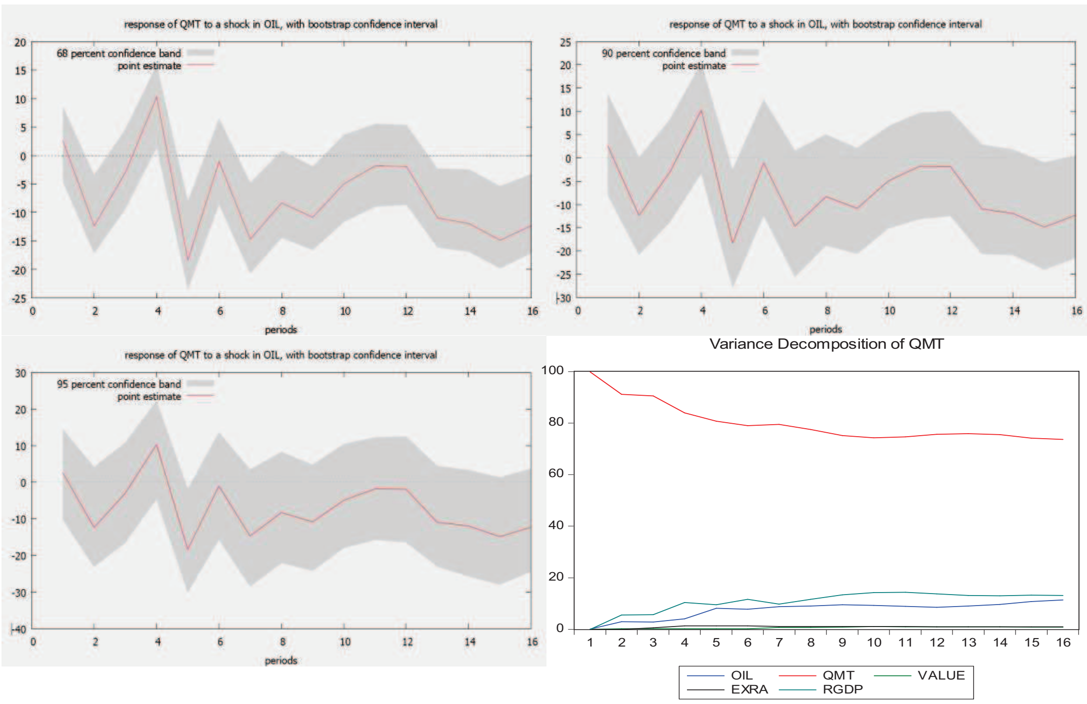
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

36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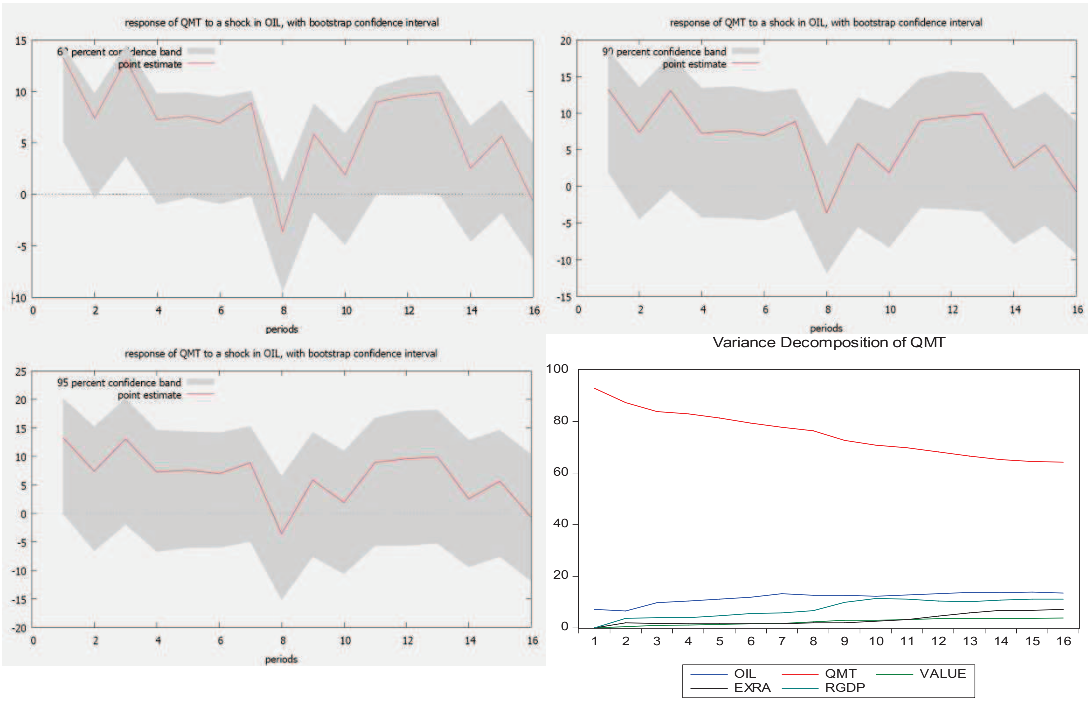
response of QMT to a shock in OIL, with bootstrap confidence interval
95 percent confidence band
point estimate
periods
Variance Decomposition of QMT
OIL
QMT
VALUE
EXRA
RGDP

37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95 percent confidence band
point estimate
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Variance Decomposition of QMT
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5 Trade Distance and Competitiveness Analysis Data

Section 5 of the appendix contains the data used for the trade distance analyses and the competitiveness analyses conduced for the 64 steel exporting countries in section 6.2 of the dissertation. The data are provided in tabular form. The tables include data on domestic coking coal production, coking coal trade distances, domestic iron ore production, iron ore trade distances, steel trade distances, stage of development, overall competitiveness, overall and port infrastructure, domestic and foreign market size, and labour costs.

5.1 European Union

[redacted]

Domestic Coking Coal Production (in TST) - European Union

Country	2005	2006	2007	2008
Austria	1,530	1,541	1,570	1,554
Belgium	3,148	3,191	2,874	2,545
Bulgaria	819	737	579	369
Czech Republic	3,761	3,779	3,591	3,747
Denmark	0	0	0	0
Estonia	41	36	44	39
Finland	985	959	953	948
France	4,900	5,169	4,922	4,947
Germany	9,256	9,229	9,305	9,085
Hungary	677	1,015	1,121	1,101
Ireland	0	0	0	0
Italy	5,042	5,168	5,211	4,944
Latvia	0	0	0	0
Lithuania	0	0	0	0
Luxembourg	0	0	0	0
Netherlands	2,467	2,383	2,384	2,299
Poland	9,264	10,597	11,208	11,106
Portugal	0	0	0	0
Romania	2,084	1,973	1,816	1,254
Slovakia	2,035	2,046	1,927	1,744
Spain	2,934	3,129	3,023	2,917
Sweden	1,555	1,310	1,316	1,296
United Kingdom	4,810	5,103	4,934	4,805

Source: EIA n.d.f

Table 5.2 Coking Coal Trade Distances (in km) - European Union

Country	Port of Destination	Port of Departure		
		Australia (Newcastle)	U.S. Gulf Coast (Mobile)	U.S. East Coast (Norfolk)
Austria	landlocked	-	-	-
Belgium	Antwerp	22,452	9,386	6,797
Bulgaria	Varna	18,088	12,599	10,216
Czech Republic	landlocked, net exporter	-	-	-
Denmark	Copenhagen	23,285	9,784	7,191
Estonia	Tallinn	24,137	10,784	8,190
Finland	Helsinki	24,146	10,792	8,199
France	Marseille	19,340	10,216	7,830
Germany	Hamburg	22,954	9,738	7,145
Hungary	landlocked	-	-	-
Ireland	Dublin	22,155	8,695	6,102
Italy	Genoa	19,079	10,532	8,149
Latvia	Riga	24,032	10,677	8,084
Lithuania	Klaipeda	23,719	10,382	7,790
Luxembourg	landlocked	-	-	-
Netherlands	Rotterdam	22,496	9,430	6,841
Poland	net exporter	-	-	-
Portugal	Lisbon	20,466	8,428	6,043
Romania	Mangalia	18,164	12,675	10,292
Slovakia	landlocked	-	-	-
Spain	Barcelona	19,435	9,879	7,495
Sweden	Malmo	23,274	9,808	7,215
United Kingdom	Liverpool	22,305	8,749	6,156

Source: Author's calculations (vesseltracker.com, Port Distance Calculator)

Table 5.3 Iron Ore (in TMT)- European Union

Country	Production of Iron Ore		Exports of Iron Ore		Imports of Iron Ore		Net Exporter (+) Net Importer (-)	
	2007	2008	2007	2008	2007	2008	2007	2008
Austria	2,149	2,000	0	0	9,006	5,017	-9,006	-5,017
Belgium-Luxembourg	n.a.	n.a.	43	90	9,662	12,726	-9,619	-12,636
Bulgaria	n.a.	n.a.	n.a.	n.a.	923	526	n.a.	n.a.
Czech Republic	n.a.	n.a.	n.a.	n.a.	5,046	6,800	n.a.	n.a.
Denmark	n.a.	n.a.	n.a.	0	43	99	n.a.	-99
Estonia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Finland	n.a.	n.a.	n.a.	n.a.	3,156	3,121	n.a.	n.a.
France	n.a.	n.a.	69	58	19,364	18,290	-19,295	-18,232
Germany	418	500	18	34	46,194	44,339	-46,176	-44,305
Hungary	n.a.	n.a.	n.a.	n.a.	967	1,900	n.a.	n.a.
Ireland	n.a.	n.a.	0	n.a.	0	0	0	n.a.
Italy	n.a.	n.a.	1	0	17,013	16,313	-17,012	-16,313
Latvia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Lithuania	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Netherlands	n.a.	n.a.	25,928	24,750	31,501	32,639	-5,573	-7,889
Poland	n.a.	n.a.	0	10	8,747	7,785	-8,747	-7,775
Portugal	n.a.	n.a.	0	n.a.	0	0	0	n.a.
Romania	n.a.	n.a.	n.a.	n.a.	6,260	4,446	n.a.	n.a.
Slovakia	300	200	4	n.a.	5,854	5,536	-5,850	n.a.
Spain	n.a.	n.a.	0	0	5,719	6,328	-5,719	-6,328
Sweden	24,713	23,800	19,034	17,617	70	71	18,964	17,546
United Kingdom	n.a.	n.a.	4	8	17,365	15,283	-17,361	-15,275
European Union	27,580	26,500	45,102	42,568	186,895	181,219	-141,793	-138,651

Source: World Steel Association 2010, Tables 46-48

Table 5.4 Iron Ore Trade Distances (in km)- European Union

Country	Port of Destination	Port of Departure	
		Australia (Hedland)	Brazil (Ponta Ubu)
Austria	landlocked	-	-
Belgium	Antwerp	18,131	9,647
Bulgaria	Varna	13,768	11,362
Czech Republic	landlocked	-	-
Denmark	Copenhagen	18,964	10,480
Estonia	Tallinn	19,816	11,334
Finland	Helsinki	19,824	11,342
France	Marseille	15,020	8,978
Germany	Hamburg	18,633	10,149
Hungary	landlocked	-	-
Ireland	Dublin	17,835	9,334
Italy	Genoa	14,759	9,297
Latvia	Riga	19,711	11,227
Lithuania	Klaipeda	19,398	10,916
Luxembourg	landlocked	-	-
Netherlands	Rotterdam	18,176	9,692
Poland	Gdansk	19,320	10,838
Portugal	Lisbon	16,146	7,710
Romania	Mangalia	13,844	11,440
Slovakia	landlocked	-	-
Spain	Barcelona	15,114	8,641
Sweden	Malmo	18,952	10,469
United Kingdom	Liverpool	17,983	9,482

Source: Author's calculations (vesseltracker.com, Port Distance Calculator)

Table 5.5 Steel Trade Distances (in km)- European Union

Country	Port of Destination	Port of Departure		
		U.S. West Coast (Long Beach)	U.S. Gulf Coast (New Orleans)	U.S. East Coast (New York)
Austria	landlocked	-	-	-
Belgium	Antwerp	15,116	9,506	6,424
Bulgaria	Varna	17,960	12,720	9,843
Czech Republic	landlocked	-	-	-
Denmark	Copenhagen	15,691	9,906	6,820
Estonia	Tallinn	16,690	10,904	7,819
Finland	Helsinki	16,697	10,911	7,826
France	Marseille	15,575	10,336	7,460
Germany	Hamburg	15,617	9,858	6,775
Hungary	landlocked	-	-	-
Ireland	Dublin	14,493	8,815	5,730
Italy	Genoa	15,893	10,654	7,776
Latvia	Riga	16,582	10,797	7,711
Lithuania	Klaipeda	16,290	10,504	7,419
Luxembourg	landlocked	-	-	-
Netherlands	Rotterdam	15,160	9,550	6,469
Poland	Gdansk	16,223	10,437	7,325
Portugal	Lisbon	13,849	8,548	5,672
Romania	Mangalia	18,036	12,797	9,919
Slovak Republic	landlocked	-	-	-
Spain	Barcelona	15,240	10,000	7,122
Sweden	Malmo	15,716	9,930	6,844
United Kingdom	Liverpool	14,643	8,871	5,785

Source: Author's calculations (vesseltracker.com, Port Distance Calculator)

Table 5.6 Country / Economy Profiles - European Union

Country / Economy Profiles - European Union						
Country	Stage of Development	GCI / (Rank, out of 134)	Quality of Infrastructure (Rank)		Market Size (Rank)	
			Overall	Port	Domestic	Foreign
Austria	Innovation driven / 3	14	6	34	34	37
Belgium	Innovation driven / 3	19	15	7	28	20
Bulgaria	Efficiency driven / 2	76	109	79	60	59
Czech Republic	Innovation driven / 3	33	51	61	40	26
Denmark	Innovation driven / 3	3	7	5	46	44
Estonia	Transition / 2-3	32	37	20	93	77
Finland	Innovation driven / 3	6	5	6	50	47
France	Innovation driven / 3	16	4	10	7	10
Germany	Innovation driven / 3	7	3	4	5	3
Hungary	Transition / 2-3	62	55	70	49	33
Ireland	Innovation driven / 3	22	64	64	51	35
Italy	Innovation driven / 3	49	73	95	10	12
Latvia	Transition / 2-3	54	59	52	79	80
Lithuania	Transition / 2-3	44	47	43	70	69
Luxembourg	Innovation driven / 3	25	14	21	97	56
Netherlands	Innovation driven / 3	8	17	3	20	14
Poland	Transition / 2-3	53	110	119	19	22
Portugal	Innovation driven / 3	43	23	42	39	51
Romania	Efficiency driven / 2	68	117	102	36	53
Slovakia	Transition / 2-3	46	65	56	58	46
Spain	Innovation driven / 3	29	27	33	11	19
Sweden	Innovation driven / 3	4	12	13	32	28
United Kingdom	Innovation driven / 3	12	24	30	6	8

Source: Schwab and Porter 2008

Table 5.7 Labour Costs 2007 - European Union

Country	Manufacturing Wages (in U.S. $)	Hourly Compensation Costs (in U.S. $)	
		Primary Metal Manufacturing	Fabricated Product Manufacturing
Austria	20.86	49.57	n.a.
Belgium	22.88	46.97	37.82
Bulgaria	n.a.	n.a.	n.a.
Czech Republic	5.88	11.21	9.44
Denmark	32.56	n.a.	n.a.
Estonia	5.66	n.a.	n.a.
Finland	23.07	44.30	34.17
France	20.30	42.31	33.26
Germany	25.05	55.09	41.17
Hungary	4.71	11.68	6.98
Ireland	24.76	32.75	28.59
Italy	17.80	33.17	31.63
Latvia	n.a.	n.a.	n.a.
Lithuania	n.a.	n.a.	n.a.
Luxembourg	n.a.	n.a.	n.a.
Netherlands	22.65	n.a.	n.a.
Poland	4.49	10.04	7.78
Portugal	6.78	n.a.	n.a.
Romania	n.a.	n.a.	n.a.
Slovakia	4.69	14.15	7.96
Spain	13.48	32.11	22.69
Sweden	23.80	42.04	34.19
United Kingdom	25.46	34.62	31.96

Source: U.S. Bureau of Labor Statistics 2011

5.2 Other Europe

Table 5.8 Domestic Coking Coal Production (in TST) - Other Europe

Country	2005	2006	2007	2008
Norway	0	0	0	0
Switzerland	0	0	0	0

Source: EIA n.d.f

Table 5.9 Coking Coal Trade Distances (in km)- Other Europe

Country	Port of Destination	Port of Departure		
		Australia (Newcastle)	U.S. Gulf Coast (Mobile)	U.S. East Coast (Norfolk)
Norway	Oslo	23,437	9,675	7,082
Switzerland	landlocked	-	-	-

Source: Author's calculations (vesseltracker.com, Port Distance Calculator)

[redacted]

Country	Production of Iron Ore		Exports of Iron Ore		Imports of Iron Ore		Net Exporter (+) Net Importer (-)	
	2007	2008	2007	2008	2007	2008	2007	2008
Norway	609	600	740	615	180	152	560	463
Switzerland	n.a.	n.a.	n.a.	n.a.	8	6	n.a.	n.a.
Other Europe	1,909	1,800	2,054	1,315	3,187	3,258	-1,133	-1,943

Source: World Steel Association 2010, Tables 46-48

Table 5.11 Iron Ore Trade Distances (in km) - Other Europe

Country	Port of Destination	Port of Departure: Australia (Hedland)	Port of Departure: Brazil (Ponta Ubu)
Norway	Oslo	19,135	10,632
Switzerland	landlocked	-	-

Source: Author's calculations (vesseltracker.com, Port Distance Calculator)

Table 5.12 Steel Trade Distances (in km) - Other Europe

Country	Port of Destination	Port of Departure: U.S. West Coast (Long Beach)	U.S. Gulf Coast (New Orleans)	U.S. East Coast (New York)
Norway	Stavanger	15,149	9,363	6,278
Switzerland	landlocked	-	-	-

Source: Author's calculations (vesseltracker.com, Port Distance Calculator)

Table 5.13 Country / Economy Profiles - Other Europe

Country / Economy Profiles - Other Europe

Country	Stage of Development	GCI / (Rank, out of 134)	Quality of Infrastructure (Rank): Overall	Quality of Infrastructure (Rank): Port	Market Size (Rank): Domestic	Market Size (Rank): Foreign
Norway	Innovation driven / 3	15	28	12	44	42
Switzerland	Innovation driven / 3	2	1	17	37	30

Source: Schwab and Porter 2008

Table 5.14 Labour Costs 2007 - Other Europe

Country	Manufacturing Wages (in U.S. $)	Hourly Compensation Costs (in U.S. $): Primary Metal Manufacturing	Hourly Compensation Costs (in U.S. $): Fabricated Product Manufacturing
Norway	n.a.	53.57	n.a.
Switzerland	28.17	n.a.	n.a.

Source: U.S. Bureau of Labor Statistics 2011

5.3 C.I.S.

[redacted]

Country	2005	2006	2007	2008
Kazakhstan	2,747	2,897	3,224	2,963
Russia	33,067	33,842	35,554	35,364
Ukraine	20,806	21,191	22,678	21,539

Source: EIA n.d.f

Table 5.16 Coking Coal Trade Distances (in km) - C.I.S.

Country	Port of Destination	Port of Departure		
		Australia (Newcastle)	U.S. Gulf Coast (Mobile)	U.S. East Coast (Norfolk)
Kazakhstan	net exporter	-	-	-
Russia	net exporter	-	-	-
Ukraine	Sevastopol	18,387	12,897	10,514

Source: Author's calculations (vesseltracker.com, Port Distance Calculator)

Table 5.17 Iron Ore (in TMT) - C.I.S.

Country	Production of Iron Ore		Exports of Iron Ore		Imports of Iron Ore		Net Exporter (+) Net Importer (-)	
	2007	2008	2007	2008	2007	2008	2007	2008
Kazakhstan	18,908	17,144	13,153	15,200	183	1,936	12,970	13,264
Russia	104,953	99,272	31,761	24,630	10,682	11,752	21,079	12,878
Ukraine	77,429	71,721	20,723	22,779	3,482	2,869	17,241	19,910
C.I.S.	201,290	188,137	65,638	62,609	14,347	16,556	51,291	46,053

Source: World Steel Association 2010, Tables 46-48

Table 5.18 Iron Ore Trade Distances (in km) - C.I.S.

Country	Port of Destination	Port of Departure	
		Australia (Hedland)	Brazil (Ponta Ubu)
Kazakhstan	landlocked* (*Caspian Sea)	-	-
Russia	St. Peterburg (West Coast)	20,098	11,616
	Vladivostok (East Coast)	7,830	22,641
Ukraine	Sevastopol	14,066	11,662

Source: Author's calculations (vesseltracker.com, Port Distance Calculator)

Table 5.19 Steel Trade Distances (in km) - C.I.S.

Country	Port of Destination	Port of Departure: U.S. West Coast (Long Beach)	U.S. Gulf Coast (New Orleans)	U.S. East Coast (New York)
Kazakhstan	landlocked	-	-	-
Russia	St. Petersburg (West Coast)	16,971	11,186	8,100
	Nakhodka (East Coast)	9,697	18,014	19,172
Ukraine	Sevastopol	18,258	13,019	10,141

Source: Author's calculations (vesseltracker.com, Port Distance Calculator)

Table 5. 20 Country / Economy Profiles - C.I.S.

Country / Economy Profiles - C.I.S.						
Country	Stage of Development	GCI / (Rank, out of 134)	Quality of Infrastructure (Rank)		Market Size (Rank)	
			Overall	Port	Domestic	Foreign
Kazakhstan	Transition / 1-2	66	71	101	54	49
Russia	Transition / 2-3	51	78	76	8	6
Ukraine	Efficiency driven / 2	72	86	87	29	37

Source: Schwab and Porter 2008

Table 5.21 Labour Costs 2007 - C.I.S.

Country	Manufacturing Wages (in U.S. $)	Hourly Compensation Costs (in U.S. $): Primary Metal Manufacturing	Fabricated Product Manufacturing
Kazakhstan	n.a.	n.a.	n.a.
Russia	n.a.	n.a.	n.a.
Ukraine	n.a.	n.a.	n.a.

Source: U.S. Bureau of Labor Statistics 2011

5.4 North America

Table 5.22 Domestic Coking Coal Production (in TST) - North America

Country	2005	2006	2007	2008
Canada	3,643	3,526	3,415	3,351
Costa Rica	0	0	0	0
Dominican Republic	0	0	0	0
El Salvador	0	0	0	0
Guatemala	0	0	0	0
Honduras	0	0	0	0
Panama	0	0	0	0
Trinidad and Tobago	0	0	0	0

Source: EIA n.d.f

Table 5.23 Coking Coal Trade Distances (in km) – North America

Country	Port of Destination	Port of Departure		
		Australia (Newcastle)	U.S. Gulf Coast (Mobile)	U.S. East Coast (Norfolk)
Canada	net exporter	-	-	-
Costa Rica	Caldera (West Coast)	14,612	3,728	4,528
	Puerto Limon (East Coast)	15,725	2,495	3,687
Dominican Republic	Santo Domingo	16,920	3,071	2,797
El Salvador	Acajutla	14,236	4,450	5,250
Guatemala	Quetzal (West Coast)	14,183	4,556	5,354
	Santo Tomas de Castilla (East Coast)	16,966	1,813	3,098
Honduras	San Lorenzo (West Coast)	14,507	4,295	5,095
	La Ceiba (East Coast)	16,720	1,859	3,108
Mexico	Mazatlan (West Coast)	12,995	6,732	7,530
	Veracruz (East Coast)	18,268	1,591	3,495
Panama	Balboa (Southern Coast)	15,305	2,806	3,606
	Colon (Northern Coast)	15,375	2,741	3,539
Trinidad and Tobago	Port of Spain	17,685	4,026	3,721

Source: Author's calculations (vesseltracker.com, Port Distance Calculator)

Table 5.24 Iron Ore (in TMT) - North America

Country	Production of Iron Ore		Exports of Iron Ore		Imports of Iron Ore		Net Exporter (+) Net Importer (-)	
	2007	2008	2007	2008	2007	2008	2007	2008
Canada	34,100	32,100	28,139	28,056	7,269	9,073	20,870	18,983
Dominican Republic	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
El Salvador	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Guatemala	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Honduras	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Mexico	10,900	11,500	1,381	1,952	3,127	3,875	-1,746	-1,923
Panama	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Trinidad and Tobago	n.a.	n.a.	n.a.	n.a.	2,894	4,252	n.a.	n.a.
North America	97,400	96,600	38,818	41,172	22,679	26,436	16,139	14,736

Source: World Steel Association 2010, Tables 46-48

Table 5.25 Iron Ore Trade Distances (in km) - North America

Country	Port of Destination	Port of Departure	
		Australia (Hedland)	Brazil (Ponta Ubu)
Canada	Vancouver (West Coast)	14,927	15,657
	Halifax (East Coast)	20,731	8,688
Costa Rica	Caldera (West Coast)	18,935	8,766
	Limon (East Coast)	20,089	8,080
Dominican Republic	Santo Domingo	21,283	6,851
El Salvador	Acajutla	18,307	9,488
Guatemala	Quetzal (West Coast)	18,209	9,592
	Santo Tomas de Castilla (East Coast)	21,331	8,734
Honduras	San Lorenzo (West Coast)	18,577	9,332
	La Ceiba (East Coast)	21,083	8,486
Mexico	Mazatlan (West Coast)	16,531	11,768
	Veracruz (East Coast)	22,633	9,871
Panama	Balboa (Southern Coast)	19,670	7,843
	Colon (Northern Coast)	19,740	7,777
Trinidad and Tobago	Port of Spain	11,240	5,691

Source: Author's calculations (vesseltracker.com, Port Distance Calculator)

Table 5.26 Steel Trade Distances (in km) - North America

Country	Port of Destination	Port of Departure: U.S. West Coast (Long Beach)	U.S. Gulf Coast (New Orleans)	U.S. East Coast (New York)
Canada	Vancouver (West Coast)	2,274	10,593	11,749
	Halifax (East Coast)	10,313	4,307	1,140
Costa Rica	Caldera (West Coast)	4,902	3,702	4,857
	Limon (East Coast)	6,069	2,466	4,059
Dominican Republic	Santo Domingo	7,263	3,042	3,061
El Salvador	Acajutla	4,054	4,424	5,580
Guatemala	Quetzal (West Coast)	3,950	4,528	5,683
	Santo Tomas de Castilla (East Coast)	7,310	1,785	3,470
Honduras	San Lorenzo (West Coast)	4,324	4,268	5,424
	La Ceiba (East Coast)	7,063	1,833	3,479
Mexico	Manzanillo (West Coast)	2,363	6,107	7,263
	Veracruz (East Coast)	8,611	1,448	3,866
Panama	Balboa (South Coast)	5,648	2,780	3,935
	Cristobal (North Coast)	5,718	2,713	3,868
Trinidad and Tobago	Port of Spain	8,028	4,118	3,955

Source: Author's calculations (vesseltracker.com, Port Distance Calculator)

Table 5.27 Country / Economy Profiles - North America

Country / Economy Profiles - North America

Country	Stage of Development	GCI / (Rank, out of 134)	Quality of Infrastructure (Rank): Overall	Port	Market Size (Rank): Domestic	Foreign
Canada	Innovation driven / 3	10	10	14	13	15
Dominican Republic	Efficiency driven / 2	98	75	74	71	89
El Salvador	Transition / 1-2	79	48	81	76	95
Guatemala	Transition / 1-2	84	63	63	68	96
Honduras	Factor driven / 1	82	72	36	83	88
Mexico	Efficiency driven / 2	60	76	94	12	16
Panama	Efficiency driven / 2	58	54	15	92	73
Trinidad and Tobago	Transition / 2-3	92	60	89	112	86

Source: Schwab and Porter 2008

Table 5.28 Labour Costs 2007 - North America

Country	Manufacturing Wages (in U.S. $)	Hourly Compensation Costs (in U.S. $)	
		Primary Metal Manufacturing	Fabricated Product Manufacturing
Canada	22.40	44.71	29.59
Dominican Republic	n.a.	n.a.	n.a.
El Salvador	n.a.	n.a.	n.a.
Guatemala	n.a.	n.a.	n.a.
Honduras	n.a.	n.a.	n.a.
Mexico	n.a.	5.81	3.39
Panama	n.a.	n.a.	n.a.
Trinidad and Tobago	n.a.	n.a.	n.a.

Source: U.S. Bureau of Labor Statistics 2011

5.5 South America

Table 5.29 Domestic Coking Coal Production (in TST) - South America

Country	2005	2006	2007	2008
Argentina	1,314	1,799	1,752	2,199
Brazil	8,567	8,260	9,166	9,134
Chile	543	545	627	548
Colombia	506	521	527	527
Ecuador	0	0	0	0
Peru	52	53	0	0
Uruguay	0	0	0	0

Source: EIA n.d.f

Table 5.30 Coking Coal Trade Distances (in km) – South America

Country	Port of Destination	Port of Departure: Australia (Newcastle)	U.S. Gulf Coast (Mobile)	U.S. East Coast (Norfolk)
Argentina	Buenos Aires	15,207	11,955	11,258
Brazil	Rio de Janeiro	16,480	9,853	9,156
Chile	San Antonio	12,642	7,849	8,647
Colombia	net exporter	-	-	-
Ecuador	La Libertad	14,388	4,130	4,930
Peru	Callao	14,123	5,347	6,145
Uruguay	Montevideo	15,079	11,740	11,043

Source: Author's calculations (vesseltracker.com, Port Distance Calculator)

Table 5.31 Iron Ore (in TMT) – South America

Country	Production of Iron Ore		Exports of Iron Ore		Imports of Iron Ore		Net Exporter (+) Net Importer (-)	
	2007	2008	2007	2008	2007	2008	2007	2008
Argentina	n.a.	n.a.	n.a.	n.a.	6,586	7,176	n.a.	n.a.
Brazil	336,526	346,000	269,448	281,683	n.a.	n.a.	n.a.	n.a.
Chile	7,871	8,400	6,715	5,400	n.a.	n.a.	n.a.	n.a.
Colombia	900	900	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Costa Rica	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Ecuador	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Peru	7,896	7,900	7,401	7,200	n.a.	n.a.	n.a.	n.a.
Uruguay	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
South America	373,843	384,700	289,453	299,783	7,258	7,882	282,195	291,901

Source: World Steel Association 2010, Tables 46-48

Table 5.32 Iron Ore Trade Distances (in km) - South America

Country	Port of Destination	Port of Departure	
		Australia (Hedland)	Brazil (Ponta Ubu)
Argentina	Buenos Aires	17,490	2,580
Chile	San Antonio	17,537	7,791
Colombia	Cartanega	20,279	7,386
Ecuador	La Libertad	18,870	9,167
Peru	Callao	18,816	10,242
Uruguay	Montevideo	17,274	2,365

Source: Author's calculations (vesseltracker.com, Port Distance Calculator)

Table 5.33 Steel Trade Distances (in km) - South America

Country	Port of Destination	Port of Departure		
		U.S. West Coast (Long Beach)	U.S. Gulf Coast (New Orleans)	U.S. East Coast (New York)
Argentina	Buenos Aires	14,716	12,949	11,352
Brazil	Rio de Janeiro (East Coast)	13,951	9,945	9,250
	Itaqui (North Coast)	10,574	6,570	5,876
Chile	Valparaiso	9,558	7,756	8,911
Colombia	Cartanega	6,258	2,763	3,653
Ecuador	La Libertad	6,002	4,104	5,260
Peru	Callao	7,122	5,318	6,476
Uruguay	Montevideo	14,588	11,832	11,138

Source: Author's calculations (vesseltracker.com, Port Distance Calculator)

Table 5.34 Country / Economy Profiles - South America

Country / Economy Profiles - South America							
Country	Stage of Development	GCI / (Rank, out of 134)	Quality of Infrastructure (Rank)		Market Size (Rank)	
			Overall	Port	Domestic	Foreign
Argentina	Efficiency driven / 2	88	89	92	21	38
Brazil	Efficiency driven / 2	64	98	123	9	23
Chile	Transition / 2-3	28	29	37	47	43
Colombia	Efficiency driven / 2	74	84	108	30	54
Costa Rica	Efficiency driven / 2	59	103	128	77	75
Ecuador	Efficiency driven / 2	104	105	109	59	72
Peru	Efficiency driven / 2	83	113	127	45	55
Uruguay	Efficiency driven / 2	75	66	50	87	94

Source: Schwab and Porter 2008

Table 5.35 Labour Costs 2007 - South America

Country	Manufacturing Wages (in U.S. $)	Hourly Compensation Costs (in U.S. $)	
		Primary Metal Manufacturing	Fabricated Product Manufacturing
Argentina	5.47	11.73	6.50
Brazil	3.81	12.27	5.95
Chile	n.a.	n.a.	n.a.
Colombia	n.a.	n.a.	n.a.
Costa Rica	n.a.	n.a.	n.a.
Ecuador	n.a.	n.a.	n.a.
Peru	n.a.	n.a.	n.a.
Uruguay	n.a.	n.a.	n.a.

Source: U.S. Bureau of Labor Statistics 2011

5.6 Africa

[redacted]

Country	2005	2006	2007	2008
Algeria	651	692	685	685
Egypt	1,724	1,661	1,657	1,620
South Africa	2,100	2,363	2,212	2,011

Source: EIA n.d.f

Table 5.37 Coking Coal Trade Distances (in km) - Africa

Country	Port of Destination	Port of Departure		
		Australia (Newcastle)	U.S. Gulf Coast (Mobile)	U.S. East Coast (Norfolk)
Algeria	Algier	19,142	9,664	7,280
Egypt	Alexandria	16,559	12,282	9,899
South Africa	net exporter	-	-	-

Source: Author's calculations (vesseltracker.com, Port Distance Calculator)

[redacted]

Country	Production of Iron Ore		Exports of Iron Ore		Imports of Iron Ore		Net Exporter (+) Net Importer (-)	
	2007	2008	2007	2008	2007	2008	2007	2008
Algeria	2,000	1,700	n.a.	n.a.	543	213	n.a.	n.a.
Egypt	2,000	2,000	n.a.	n.a.	4,435	3,562	n.a.	n.a.
South Africa	41,559	49,000	30,336	31,592	n.a.	n.a.	n.a.	n.a.
Africa	57,736	64,100	42,151	42,592	7,361	6,329	34,790	36,263

Source: World Steel Association 2010, Tables 46-48

Table 5.39 Iron Ore Trade Distances (in km) - Africa

Country	Port of Destination	Port of Departure	
		Australia (Hedland)	Brazil (Ponta Ubu)
Algeria	Algier	14,820	8,427
Egypt	Alexandria	12,238	11,045
South Africa	Durban	9,391	7,752

Source: Author's calculations (vesseltracker.com, Port Distance Calculator)

Table 5.40 Steel Trade Distances (in km) - Africa

Country	Port of Destination	Port of Departure U.S. West Coast (Long Beach)	U.S. Gulf Coast (New Orleans)	U.S. East Coast (New York)
Algeria	Algiers	15,025	9,784	6,907
Egypt	Alexandria	17,644	12,402	9,526
South Africa	Durban	19,771	15,767	14,627

Source: Author's calculations (vesseltracker.com, Port Distance Calculator)

Table 5.41 Country / Economy Profiles - Africa

Country / Economy Profiles - Africa

Country	Stage of Development	GCI / (Rank, out of 134)	Quality of Infrastructure (Rank)		Market Size (Rank)	
			Overall	Port	Domestic	Foreign
Algeria	Efficiency driven / 2	99	85	103	52	41
Egypt	Factor driven / 1	81	57	69	25	39
South Africa	Efficiency driven / 2	45	46	49	22	36

Source: Schwab and Porter 2008

Table 5.42 Labour Costs 2007 - Africa

Country	Manufacturing Wages (in U.S. $)	Hourly Compensation Costs (in U.S. $)	
		Primary Metal Manufacturing	Fabricated Product Manufacturing
Algeria	n.a.	n.a.	n.a.
Egypt	n.a.	n.a.	n.a.
South Africa	n.a.	n.a.	n.a.

Source: U.S. Bureau of Labor Statistics 2011

5.7 Middle East

Table 5.43 Domestic Coking Coal Production (in TST) - Middle East

Country	2005	2006	2007	2008
Israel	0	0	0	0
Saudi Arabia	0	0	0	0
Turkey	3,298	3,542	3,676	4,383
United Arab Emirates	0	0	0	0

Source: EIA n.d.f

[redacted]

Country	Port of Destination	Port of Departure: Australia (Newcastle)	U.S. Gulf Coast (Mobile)	U.S. East Coast (Norfolk)
Israel	Haifa	16,611	12,718	10,334
Saudi Arabia	Jedda Islamic Port	15,060	13,829	11,445
Turkey	Istanbul	17,813	12,323	9,938
United Arab Emirates	Ahmed Bin Port Rashid	13,736	17,979	15,594

Source: Author's calculations (vesseltracker.com, Port Distance Calculator)

[redacted]

Country	Production of Iron Ore		Exports of Iron Ore		Imports of Iron Ore		Net Exporter (+) Net Importer (-)	
	2007	2008	2007	2008	2007	2008	2007	2008
Israel	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Saudi Arabia	n.a.	n.a.	n.a.	n.a.	4,931	7,638	n.a.	n.a.
Turkey	3,820	3,700	n.a.	n.a.	6,088	6,900	n.a.	n.a.
United Arab Emirates	n.a.	n.a.	n.a.	n.a.	896	300	n.a.	n.a.
Middle East	25,820	23,700	3,988	3,800	16,716	25,746	-12,728	-21,946

Source: World Steel Association 2010, Tables 46-48

Table 5.46 Iron Ore Trade Distances (in km) - Middle East

Country	Port of Destination	Port of Departure	
		Australia (Hedland)	Brazil (Ponta Ubu)
Israel	Haifa	12,290	11,481
Saudi Arabia	Jedda Islamic Port	10,740	12,592
Turkey	Istanbul	13,490	11,086
United Arab Emirates	Ahmed Bin Port Rashid	8,945	15,636

Source: Author's calculations (vesseltracker.com, Port Distance Calculator)

Table 5.47 Steel Trade Distances (in km) - Middle East

Country	Port of Destination	Port of Departure		
		U.S. West Coast (Long Beach)	U.S. Gulf Coast (New Orleans)	U.S. East Coast (New York)
Israel	Haifa	18,079	12,839	9,961
Saudi Arabia	Jedda Islamic Port	19,190	13,951	11,073
Turkey	Istanbul	17,682	12,443	9,567
United Arab Emirates	Jebel Ali Terminal	21,485	18,192	15,316

Source: Author's calculations (vesseltracker.com, Port Distance Calculator)

Table 5.48 Country / Economy Profiles - Middle East

Country / Economy Profiles - Middle East						
Country	Stage of Development	GCI / (Rank, out of 134)	Quality of Infrastructure (Rank)		Market Size (Rank)	
			Overall	Port	Domestic	Foreign
Israel	Innovation driven / 3	23	42	53	48	50
Saudi Arabia	Transition / 1-2	27	38	45	21	26
Turkey	Transition / 2-3	63	70	88	15	25
United Arab Emirates	Innovation driven / 3	31	11	8	55	32

Source: Schwab and Porter 2008

Table 5.49 Labour Costs 2007 - Middle East

Country	Manufacturing Wages (in U.S. $)	Hourly Compensation Costs (in U.S. $)	
		Primary Metal Manufacturing	Fabricated Product Manufacturing
Israel	12.52	13.20	12.38
Saudi Arabia	n.a.	n.a.	n.a.
Turkey	n.a.	n.a.	n.a.
United Arab Emirates	n.a.	n.a.	n.a.

Source: U.S. Bureau of Labor Statistics 2011

5.8 Asia

Table 5.50 Domestic Coking Coal Production (in TST) - Asia

Country	2005	2006	2007	2008
China	276,688	324,766	361,261	353,087
Hong Kong	0	0	0	0
India	14,713	13,852	13,825	13,910
Indonesia	0	0	0	0
Japan	41,898	42,681	42,844	40,291
Malaysia	0	0	0	0
Philippines	0	0	0	0
Singapore	0	0	0	0
South Korea	9,849	10,900	10,942	11,968
Taiwan	4,858	4,737	4,675	4,664
Thailand	0	0	0	0

Source: EIA n.d.f

Table 5.51 Coking Coal Trade Distances (in km) - Asia

Country	Port of Destination	Port of Departure		
		Australia (Newcastle)	U.S. Gulf Coast (Mobile)	U.S. East Coast (Norfolk)
China	Shanghai	8,721	19,626	20,426
Hong Kong	Hong Kong	8,601	20,879	21,681
India	Mumbai	11,866	18,272	15,888
Indonesia	net exporter	-	-	-
Japan	Tokyo	8,236	17,872	18,670
Malaysia	Port Klang	8,323	21,802	19,416
Philippines	Manila	7,515	21,070	21,868
Singapore	Port of Singapore	7,978	21,981	19,648
South Korea	Busan	8,710	18,692	19,490
Taiwan	Keelung	8,143	19,989	20,787
Thailand	Bangkok	9,266	23,446	21,185

Source: Author's calculations (vesseltracker.com, Port Distance Calculator)

Table 5.52 Iron Ore (in TMT) - Asia

Country	Production of Iron Ore		Exports of Iron Ore		Imports of Iron Ore		Net Exporter (+) Net Importer (-)	
	2007	2008	2007	2008	2007	2008	2007	2008
China	1,039,397	1,190,011	78	10	383,093	444,028	-383,015	-444,018
Hong Kong	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
India	206,939	214,000	93,728	101,400	1,122	600	92,606	100,800
Indonesia	20	100	706	1,000	1,737	2,300	-1,031	-1,300
Japan	n.a.	n.a.	26	0	138,928	140,351	-138,902	-140,351
Malaysia	800	800	828	900	2,677	3,043	-1,849	-2,143
Philippines	n.a.	n.a.	n.a.	n.a.	2,627	2,700	n.a.	n.a.
Singapore	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
South Korea	400	200	n.a.	n.a.	43,722	49,542	n.a.	n.a.
Taiwan	n.a.	n.a.	n.a.	n.a.	16,035	15,571	n.a.	n.a.
Thailand	1,500	1,600	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Asia	543,883	584,900	97,189	105,400	592,846	661,166	-495,657	-555,766

Source: World Steel Association 2010, Tables 46-48

Table 5.53 Iron Ore Trade Distances (in km) - Asia

Country	Port of Destination	Port of Departure	
		Australia (Hedland)	Brazil (Ponta Ubu)
China	Shanghai	6,354	21,061
Hong Kong	Hong Kong	5,410	19,605
India	Mumbai	7,071	15,248
Indonesia	Jakarta	2,730	16,251
Japan	Tokyo	7,119	22,494
Malaysia	Klang	3,708	16,707
Philippines	Manila	4,348	19,253
Singapore	Port of Singapore	3,365	16,937
South Korea	Busan	6,867	21,680
Taiwan	Keelung	5,612	20,368
Thailand	Bangkok	4,650	18,474

Source: Author's calculations (vesseltracker.com, Port Distance Calculator)

Table 5.54 Steel Trade Distances (in km) - Asia

Country	Port of Destination	Port of Departure		
		U.S. West Coast (Long Beach)	U.S. Gulf Coast (New Orleans)	U.S. East Coast (New York)
China	Shanghai	11,280	19,597	20,755
Hong Kong	Hong Kong	12,534	20,851	22,009
India	Mumbai	19,518	18,394	15,516
Indonesia	Jakarta	15,217	23,049	20,173
Japan	Tokyo	9,524	17,844	19,001
Malaysia	Klang	15,241	21,922	19,045
Philippines	Manila	12,723	21,042	21,844
Singapore	Port of Singapore	14,897	22,151	19,275
South Korea	Busan	10,345	18,664	19,821
Taiwan	Keelung	11,641	19,960	21,116
Thailand	Bangkok	15,099	23,418	20,812

Source: Author's calculations (vesseltracker.com, Port Distance Calculator)

Table 5.55 Country / Economy Profiles - Asia

Country / Economy Profiles - Asia						
Country	Stage of Development	GCI / (Rank, out of 134)	Quality of Infrastructure (Rank)		Market Size (Rank)	
			Overall	Port	Domestic	Foreign
China	Transition / 1-2	30	58	54	2	1
Hong Kong	Innovation driven / 3	11	8	2	38	7
India	Factor driven / 1	50	90	93	4	5
Indonesia	Factor driven / 1	55	96	104	16	24
Japan	Innovation driven / 3	9	16	25	3	4
Malaysia	Efficiency driven / 2	21	19	16	35	17
Philippines	Factor driven / 1	71	94	100	33	40
Singapore	Innovation driven / 3	5	2	1	53	11
South Korea	Innovation driven / 3	13	18	29	14	9
Taiwan	Transition / 2-3	17	22	18	18	13
Thailand	Efficiency driven / 2	34	35	48	23	18

Source: Schwab and Porter 2008

Table 5.56 Labour Costs 2007 - Asia

Country	Manufacturing Wages (in U.S. $)	Hourly Compensation Costs (in U.S. $)	
		Primary Metal Manufacturing	Fabricated Product Manufacturing
China	1.06	n.a.	n.a.
Hong Kong	n.a.	n.a.	n.a.
India	1.17	n.a.	n.a.
Indonesia	n.a.	n.a.	n.a.
Japan	13.45	32.41	20.83
Malaysia	n.a.	n.a.	n.a.
Philippines	1.19	1.66	1.16
Singapore	10.45	n.a.	12.17
South Korea	n.a.	21.40	14.35
Taiwan	n.a.	10.69	6.28
Thailand	n.a.	n.a.	n.a.

Source: U.S. Bureau of Labor Statistics 2011

5.9 Oceania

[redacted]

Country	2005	2006	2007	2008
Australia	4,198	4,006	4,006	4,008
New Zealand	463	462	468	448

Source: EIA n.d.f

Table 5.58 Coking Coal Trade Distances (in km) - Oceania

Country	Port of Destination	Port of Departure		
		Australia (Newcastle)	U.S. Gulf Coast (Mobile)	U.S. East Coast (Norfolk)
New Zealand	net exporter	-	-	-

Source: Author´s calculations (vesseltracker.com, Port Distance Calculator)

Table 5.59 Iron Ore (in TMT) – Oceania

Country	Production of Iron Ore		Exports of Iron Ore		Imports of Iron Ore		Net Exporter (+) Net Importer (-)	
	2007	2008	2007	2008	2007	2008	2007	2008
Australia	299,061	349,800	268,574	308,931	4,217	4,649	264,357	304,282
New Zealand	2,260	2,300	577	500	n.a.	n.a.	n.a.	n.a.
Oceania	301,321	352,100	269,151	309,431	4,217	4,649	264,934	304,782

Source: World Steel Association 2010, Tables 46-48

Table 5.60 Iron Ore Trade Distances (in km) - Oceania

Country	Port of Destination	Port of Departure	
		Australia (Hedland)	Brazil (Ponta Ubu)
New Zealand	Auckland	7,897	15,955

Source: Author's calculations (vesseltracker.com, Port Distance Calculator)

Table 5.61 Steel Trade Distances (in km) - Oceania

Country	Port of Destination	Port of Departure		
		U.S. West Coast (Long Beach)	U.S. Gulf Coast (New Orleans)	U.S. East Coast (New York)
Australia	Melbourne	13,930	19,062	20,218
New Zealand	Auckland	12,169	17,301	18,457

Source: Author's calculations (vesseltracker.com, Port Distance Calculator)

Table 5.62 Country / Economy Profiles - Oceania

Country / Economy Profiles - Oceania

Country	Stage of Development	GCI / (Rank, out of 134)	Quality of Infrastructure (Rank)		Market Size (Rank)	
			Overall	Port	Domestic	Foreign
Australia	Innovation driven / 3	18	25	41	17	34
New Zealand	Innovation driven / 3	24	50	23	57	71

Source: Schwab and Porter 2008

Table 5.63 Labour Costs 2007 - Oceania

Country	Manufacturing Wages (in U.S. $)	Hourly Compensation Costs (in U.S. $)	
		Primary Metal Manufacturing	Fabricated Product Manufacturing
Australia	23.90	38.34	30.59
New Zealand	15.95	n.a.	n.a.

Source: U.S. Bureau of Labor Statistics 2011

6 The Iron Ore and Coking Coal Trades

Iron ore and coking coal are essential raw materials for steel production. Stopford (2009: 445) describes their importance as follows: "If oil is the energy of modern industrial society, the major bulks are the building-blocks from which it is constructed. Iron ore and coking coal are the raw materials of steelmaking, and steel is the principal material used in the construction of industrial and domestic buildings, motor cars, merchant ships, machinery and the great majority of industry products." The seaborne iron ore (A5.1) and coking coal trades (A.5) are briefly introduced below.

6.1 Seaborne Iron Ore Trade

Iron ore is a very dense raw material with a stowage factor of 0.4 m^3 per ton and a low-value commodity worth about $40 per ton and is almost exclusively shipped via ocean. The commodity is the largest of the major bulk commodity trades and the basic ingredient for steel production. About 98% of iron ore produced is used for the production of iron and steel. On average, it takes 2.5 tons of iron ore to produce one ton of steel. (Hummels 2007a, b; Stopford 2009: 446ff., 572; UNCTAD 2009).

Between 1965 and 2005, seaborne iron ore trade grew from 152mt to 650mt which is equivalent to a growth rate of 3.7% per annum. In 2008, iron ore trade increased to 844mt, an increase of 6.5% over 2007 (Stopford 2009: 446; UNCTAD 2008, 2009). In 2008, Australia (309.5mt; 37% of global exports) and Brazil (281.7mt; 33% of global exports) accounted for 70% of total iron ore exports.

India (101.1mt), South Africa (33.8mt), Canada (22.4mt) and Sweden (16.8mt) were also significant exporters. China is the biggest importer of iron ore. Chinese imports increased to 444mt in 2008 up from 383mt in 2007 and accounted for 53% of worldwide iron ore imports (UNCTAD 2009). Table 6.1 shows iron ore import-export relationships for certain countries and regions in 2004.

Table 6.1 Seaborne Iron Ore Trade 2004

To:		Mediter-	Other				Other		Total	
From:	UK/Cont.	ranean	Europe	USA	Japan	China	Far East	Others	mt	%
Scandinavia	7	1	1			1	0	7	16	3%
Other Europe	0					0	1	3	5	1%
West Africa	8		1					3	11	2%
S. Africa	7	0	3		10	17	2	2	42	7%
North America	12	1	0		1	2	2	4	23	4%
Brazil	46	2	8	7	27	54	21	38	205	35%
S.America Pac.				0	4	6	3	1	14	2%
India	1	0			22	40	4	2	68	12%
Australia	15	1	1	0	70	70	39	5	206	35%
Total 2004	95	6	14	8	140	190	71	66	590	100%

Source: Fearnleys Review, 2005 ; cited by Stopford 2009: 449

Iron ore ocean transport is relatively uncomplicated (Carruthers et al. 2003: 127) and predestined for generating economies of scale because iron ore can be stockpiled (Sampson and Yeats 1977; Stopford 2009: 420). Therfore, the size of ships used to transport iron ore has grown constantly over time and usually the largest ships available are employed (Quinet and Vickerman 2004: 450). In 1977, more than 50% of iron ore trade was conducted by ships bigger than 100,000dwt. Until the early 1990s, this share had grown to more than 70%. At the same time, only 4-5% of iron ore was transported by vessels smaller than 40,000dwt (Lundgren 1996). In 2007, the standard size of bulk carriers transporting iron ore was 150,000-180,000dwt and the largest vessels used are capable of transporting 300,000dwt. The average size of iron ore shipments (147,804dwt) is the largest of all major bulk commodities (Stopford 2009: 421, 447, 591).

The trade distance between iron ore exporters and importers has increased since the 1960s due to the import of high-grade iron ore from distant locations. In the early 1960s, less than 20% of worldwide iron ore production was traded between different continents. This figure increased to about 30% in the 1970s and to about 35% in the late 1980s (Lundgren 1996; Du Jonchay 1978). Stopford (2009: 146) reports a “rapid growth in the average haul in the iron ore and coal trades, both of which increased steadily from about 3000 miles in 1963 to over 5000 miles by the early 1980s.” As a result, increasingly globalised markets have arisen for bulk products like coal and iron ore (Lundgren 1996). This trend continued unabated during much of the 2000s (Stopford 2009: 450).

Table 6.2 shows the increase of ton-miles in iron ore trade over time. Ton-miles in the bulk trade are expected to increase further with China’s iron ore needs being increasingly met by new suppliers such as Latin America (UNCTAD 2008). Therefore, distance has become the main driver of iron ore transport costs.

Table 6.2 Iron Ore Trade

Iron Ore Trade (in Billions of Ton-Miles)

	1970	1980	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008
iron ore	1,093	1,613	1,978	2,545	2,575	2,731	3,035	3,444	3,918	4,192	4,544	4,849

Source: Fearnleys Review, various issues; cited by UNCTAD 2009

The consequences of increasing distance and increasing fuel costs for the iron ore trades became obvious in 2007/2008. In early 2008, iron ore transport costs from Brazil to China were at $64.05 per ton up from $35.50 per ton in 2007. In May 2008, shipping costs per ton had already reached $101.80 per ton. While iron ore freight rates for the Brazil-China route peaked in mid-2008 at nearly $108 per ton, shipping iron ore from comparatively nearby Australia to China only cost $45 per ton (UNCTAD 2008, 2009).

6.2 Seaborne Coking Coal Trade

The coal market consists of two different segments. Coking coal is used for steelmaking, and thermal coal is used to fuel power stations (Lundgren 1996; Stopford 2009: 450). The seaborne coal trade is the second-largest dry bulk trade after the iron ore trade and has become increasingly globalised in recent decades. Lundgren (1996) reports a significant increase in long-distance coal trade since the late 1970s. Between 1970 and 2008, coal trade increased from 481 to 3,905 billion ton-miles (UNCTAD 2009). Between 1986 and 2005, seaborne coking coal trade increased from 141mt to 191mt at an average of 1.6% per annum (Stopford 2009: 387). In 2008, coking coal shipments reached 224.4mt, an increase of 4.1% over 2007 (UNCTAD 2009). Australia is the biggest coking coal exporter worldwide with an export total of 136.9mt in 2008 (UNCTAD 2009).The relatively moderate increase in trade between 1986 and 2005 was due the fact that China, the largest steel producer since 1996, could, until recently, cover its coking coal demand by using national reserves (Stopford 2009: 450). However, China has recently become a net importer of coking coal.

Coal is a commodity which is easy to transport (Hummels 2009; UNCTAD 2008). Internationally, it is usually transported by ship (Hummels 2007) and almost always in bulk (Stopford 2009: 419). The size of the vessels used for shipping is rather small when compared to the seaborne iron ore trade and ranges from less than 20,000dwt to more than 160,000dwt with clusters around 60,000dwt and 150,000dwt (Stopford 2009: 59). In 2001/2002, the average size of coking coal shipments was 43,257 tons compared with 147,804 tons for iron ore (Stopford 2009: 421). Therefore, there is less potential for economies of scale in the coking coal trades.

Between 1950 and 1970, long-distance transport costs for coal declined by 70% due to efficiency gains. Transport costs then increased considerably in the 1970s as a result of the oil price shocks in 1973 and 1979 (Lundgren 1996). In the 1980s and 1990s, transport costs in the coal trades decreased but this trend was reversed in the 2000s when oil prices increased significantly. For example, in 1972 transporting coal by sea from the U.S. to Japan cost $4.50 per ton. In 2004, transport costs were at $44.80 per ton (inflation-adjusted) with tendency to rise (Stopford 2009: 73).